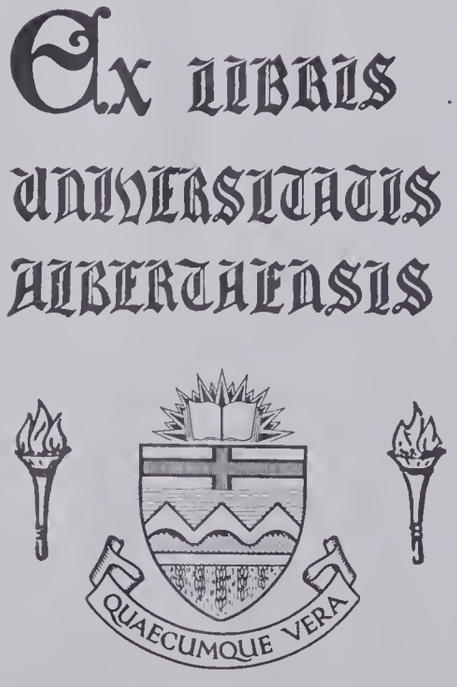

The University of Alberta
Printing Department
Edmonton, Alberta

THE UNIVERSITY OF ALBERTA

EFFECTS OF THREE COGNITIVE LEVELS OF QUESTIONS ON ACHIEVEMENT

by

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A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF EDUCATION

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBERTA

SPRING, 1970

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Effects of Three Cognitive-Levels of Questions on Achievement" submitted by Peter Harasym in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

In an attempt to determine the effects question types have upon achievement, this study explored the possibility of inducing a mental set for the objectives inherent in question types by the repetitive response to a question type after each of three reading passages. An achievement test was administered after the fourth reading passage to measure relative learning gains between groups.

A sample of 207 students was obtained from the Grade XI and XII Alberta populations. The treatment effect of repeatedly responding to one question type was administered and four achievement subscores were obtained. Each subscore represented the number of correct responses out of 15 for each of the first four cognitive-levels of Bloom's taxonomy.

Group means were compared using a multivariate technique. The analysis lead to the acceptance of the hypothesis at the .05 level of significance. As the probability of equal group means was calculated to be .08, there is evidence of possible treatment effect(s).

ACKNOWLEDGEMENTS

The writer wishes to express his sincere thanks to the members of his committee, Dr. A. C. Bower, Mr. D. Manuel, and Dr. V. R. Nyberg, for their assistance in the preparation of this thesis. Special thanks are due to Dr. Nyberg, the committee chairman, for his leadership.

Appreciation is expressed to Mr. K. Bay who assisted in the statistical analysis, and to those administrators, teachers, and the many students who helped make this thesis possible.

Special thanks are also due to my wife for her constant encouragement, patience, and understanding; and to my parents, to whom this thesis is dedicated.

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CHAPTER I

EFFECTS OF THREE LEVELS OF QUESTIONS ON ACHIEVEMENT

Background

Stimulating pupils' ability to think is one of the worthy and often mentioned aims in the teaching of any subject. The general American educational goal is cited in the Educational Policies Commission Report (1961):

> The purpose which runs through and strengthens all other educational purposes - the common thread of education - is the development of the ability to think. This is the central purpose to which the school must be oriented if it is to accomplish its traditional task or those accentuated by recent changes in the world. To say it is central is not to say it is the sole purpose, but it must be a pervasive concern in the work of the school (p. 31).

Some educators and psychologists support the idea that one of the ways thinking skills can be stimulated and developed is through the effective use of questions. Aschner (1961) in "Asking Questions to Trigger Thinking," states:

> Asking questions--in class discussion or on assignments and tests--is one of the basic ways by which the teacher stimulates thinking and learning. And it is by asking questions and studying the answers that the teacher measures and evaluates the thinking and learning progress of his students (p. 44).

Van Til (1961) also recognizes the importance of questions as a means of developing thinking ability. Bradley (1966) feels that, with respect to the learner, the structure or type of question is important to: (1) determine the type of cognitive (to know; thinking) skill the

child will employ in searching for and attacking questions; (2) involve the thinking skills one may learn; and (3) determine the range or scope of curriculum content one may encounter at a given moment or period of time (p. 29).

Ebel (1969) believes students tend to learn what they are tested on. This concept implies that questions have a controlling effect upon learning. Carner (1963), supporting the influence of questions upon learning, advises teachers to become more aware of the cognitive skills being developed and the type of questions asked.

The importance of questions in the educational process has been recognized from the time of Socrates to the present age of computer assisted instruction (CAI). Questions serve many purposes: (a) diagnose class and individual weaknesses, (b) motivate pupils and stimulate interest, (c) provide practice and drill, (d) guide study behavior, (e) provide information and review, (f) analyze learning success and achievement, and (g) guide and develop the thinking or cognitive processes of students.

Questions, as an instructional tool, are used extensively in the educational process. Results of question-counting studies within classrooms reveal that, on the average, teachers ask one question every 30-40 seconds during class discussion (Aschner, 1961; Floyd, 1960). Thompson (1945) found that the questioning method of teaching predominates in 82% of the Iowa high school classrooms.

In an effort to improve communication among educators, and to help classify and assess educational objectives in the classrooms, a taxonomy classifying thinking skills was developed and described in a book edited by Benjamin S. Bloom (1956). A principal reason for developing the taxonomy of objectives in the cognitive domain was to provide a basis for assessing student's thinking skills, and to evaluate learning programs in terms of student's behavioral changes.

However, despite the support which researchers (Ebel, 1969; Bradley, 1966; Miller, 1966; Carner, 1963; Aschner, 1961; Van Til, 1961) give to the principle of using questions to guide and develop cognitive skills, and despite the construction of Bloom's taxonomy to measure learning changes, little research has been carried out to determine what effect various question types might have upon learning. No studies have determined what question types stimulate and develop which cognitive skills. For example, does the repetitive responding to factual questions stimulate and develop the cognitive process of memorization? Or does factual questioning stimulate and develop other cognitive processes such as application, and analysis?

As an indication of the limited amount of research in this area, a summary by Cox and Unks (1967) covering 61 current studies involving Bloom's taxonomy, reveals only one study which concerns itself with the influence of

question types. In this study the effects of two categories of questions on learning gains were measured by an achievement test. A review by Snyder (1966) reveals similar results. He cites two studies which examined the "relationship between teacher oral questioning behavior and measureable changes in students such as understanding of science, and recall of factual material (p. 14)."

The results of the above studies are limited in that they deal only with empirical observations with few questioning variables manipulated or controlled. Although these studies provide some guidelines for further research, they provide little insight as to probable cause of results.

A series of laboratory research projects in which questioning variables were controlled and manipulated has recently been completed. Rothkopf (1963, 1965, 1966) and Frase (1967, 1968a, 1968b, 1968c) examined effects of factual questions upon the retention of factual material in reading situations. Although the results of these studies are more generalizable, they too are limited in that they focus upon a very small portion of the educational and cognitive objectives--memorizing and reading for details.

As questions are used extensively within our educational process (Aschner, 1961; Floyd, 1960; Thompson, 1945), and are found in some classrooms and textbooks to predominantly measure one cognitive level (Snyder, 1966; Davis and Hunkins, 1966; Pfeiffer and Davis, 1965), and as ques-

tions are thought to be by some psychologists and educators important in the guiding of learning behavior and in the stimulation and development of cognitive skills, certainly more true experimental studies are needed that examine the effects of other question types upon higher forms of learning, in addition to the effects of factual questions upon memorization and recall.

This study will attempt to determine the effect of repetitive responding to a given question type on a student's reading and studying behavior. Changes in reading and studying will be assessed by an achievement test composed of several cognitive level questions.

This study expects to support the principle that the prior response to higher cognitive-levels of questions will increase learning; and, expects to provide insight as to which cognitive processes are stimulated by the repetitive response to a given question type.

Contributions and Implications for Education

The effect of repetitive responding to a question type and the stimulation of cognitive process(es) is important to education. If the repetitive response to knowledge type questions causes a student to search for, memorize, and recall factual information, and if this learning does not stimulate or develop higher cognitive skills, then educators may be doing a grave injustice to students by emphasizing this type of question. However, if the

repetitive response to higher cognitive-level questions causes students to search for, understand, apply, and relate factual information, then the use of these higher cognitive-level questions should be encouraged.

The effect of question types on the stimulation of cognitive process(es) could be an important educational tool for guiding learning behavior and developing cognitive abilities. By selecting the question types to which a student is exposed, educators may control the cognitive abilities which are developed throughout the school years.

Unfortunately, very little is known of the guiding effect, and the stimulation effect of question types. This study attempts to contribute to the limited knowledge in this area.

CHAPTER II

PREVIOUS RESEARCH

The review of literature and research has been divided into two parts: question as an aid to classroom learning; and, question as an aid to reading. The division, although somewhat artificial has been established to separate a host of general studies dealing with questions from a series of studies dealing with factual questions in reading situations.

Questions as an Aid to Classroom Learning

If the type of question used by teachers in their discourse and instructional materials (textbooks, assignments, examinations, etc.) is effective in guiding and developing the cognitive processes of students, then the general aims as outlined in the 1961 Educational Policies Commission Report are not being implemented in classrooms by the type of questions used. Snyder (1966) found that eight research studies on question classification conducted from 1912 to 1966 indicated the majority of questions used in education were classified as factual and demand the learner to memorize and regurgitate facts. Absence of effective question planning also exists in textbooks and other instructional material.

Davis and Hunkins (1966) classified questions using Bloom's taxonomy. On the basis of this classification, they

observed that 78% of the questions examined in three elementary social studies texts required knowledge of specific facts. The varying emphasis of subject matter within the three textbooks did not alter the emphasis of "factual" questions. Pfeiffer and Davis (1965), observed a similar emphasis of "recall" questions on teacher-made (ninth grade) tests for three different junior high school programs.

Some educators and psychologists protest the predominance of factual questions in classrooms.

> Teachers have shown a notable tendency to overemphasize the kinds of questions which are readily supported by facts or details to be found in reading. While stressing these questions reduces controversy, it also has the unfortunate results of limiting the opportunity to develop higher-level thinking skills which are so important in critical thinking (Carner, 1963, p. 548).

Miller (1966) cites examples of "closed" questions taken from "Frontiers of Thinking," which he states are the type that constitute the usual state of affairs in questioning.

> That the learning of facts, definitions, concepts, and general ideas is absolutely necessary for pupil growth cannot be denied, but that this should be the near single concern of the school is surely open to doubt. Discriminating, recognizing, and remembering must always be basic mental activities for learners, but these are not the only mental abilities that should be exercised (1966, p. 552).

Sanders (1966) in supporting the view that teachers are providing students with limited opportunity to exercise higher mental activities by neglecting the use of "higher levels" of questions, states, "as a result of overusing

the memory category, many teachers offer students too few questions requiring translation, interpretation, application, analysis, synthesis, and evaluation (p. 5)."

A study has been conducted to relate the relationship of "higher levels" of question to learning gains. Jayne (1945) related teacher's questioning to students' achievement. Oral classroom behaviors were recorded, analyzed, and related to short-term and long-term effects of pupil understanding of subject matter and their ability to recall facts. The following conclusions were drawn:

1. The ratio of teacher to pupil talk had little relation to pupil gain in information.
2. There is no difference in the relative value of thought and fact questions as far as pupil gains are concerned.
3. The number of factual questions asked by teachers is significantly related to immediate recall, but only slightly related to long-term gains in understanding and recall of subject matter.
4. There is a high relationship between the number of thought questions asked by the teacher and immediate recall on the part of the students.
5. The number of questions which are raised concerning the correctness of pupil answers is

> highly related to long-term gains, but unrelated to short-term ones (p. 11).

Kleinman (1965) separated 23 teachers into two groups on the basis of the number of critical-thinking questions asked. The teacher group that asked relatively large numbers of critical-thinking questions imparted a significantly better understanding of science to high-ability seventh and eighth grade students.

Questions as an Aid to Reading

The majority of studies conducted in this area focused on variables of question placement. Other variables considered are question type, question pacing, question frequency, question mode, and knowledge of results.

Placement of Questions

An effective technique for guiding reading behavior is the question placed either prior to or following textual material. The question sets the purpose for the pupil's reading behavior if asked beforehand, and structures his thinking behavior if asked afterwards.

A number of studies have examined the effectiveness of pre- and post-questioning on retention of content material. Frase (1967, 1968a, 1968b, 1968c, 1968d) has replicated and expanded studies performed by Rothkopf (1963, 1965, 1966) and has validated Rothkopf's findings. Their investigations indicated that a post-question is a better

method of increasing retention of material than is a pre-question.

Investigations, conducted by both researchers, have analyzed posttests which focused on (a) questions which have occurred during reading (retention questions), and (b) questions related to the section of the prose passage not tested by the retention questions (incidental questions). When questions occurred after passages both retention and incidental scores were higher than scores for pre-questions.

The finding that questions if placed either before or after textual material facilitates different learning behavior led Rothkopf to identify the phenomenon as the shaping of inspection or mathemagenic behavior. He postulated that questions placed either before or after content material has adaptive characteristics which are developed by a process of natural selection. The student starts out with some set of study activities; if this is immediately followed by successful performance on experimental questions, the same typography of mathemagenic activity tends to be maintained in the subsequent instructional segment. If, however, the student fails to answer experimental questions to his satisfaction, then he will modify his mathemagenic behavior. This process of selective modification continues until the student consistently answers the experimental questions in a satisfactory manner. Questions

placed before textual material directs question specific responses; i.e., students seem to attend to information necessary to answer the question and nothing more. In doing so, the student tends to ignore irrelevant material and attends only to that part of the passage relevant to the question asked. However, a question placed after the content passage seems to cause the reader to mentally review the material just covered and prepares him to seek information needed to answer similar questions in following passages. Thus, post-questions, questions placed after content material, seem to act both as a review and a general facilitative stimulus; whereas, pre-questions, seem to facilitate a seeking behavior for only material needed to answer the question.

Question Type

Only two studies have regarded question type as a variable. A study, by Frase (1968d), investigated effects of large and small information orienting questions upon retention of material from a short passage; and, a study by Hunkins (1966) investigated effects of knowledge and evaluation questions, classified according to Bloom's taxonomy, on achievement.

Frase (1968d) using a simple, highly structured paragraph of 36 words, constructed three types of questions over content: specific, comparative, and general. Specific questions asked for one detail from the paragraph; com-

parative questions called for the student to compare two given facts; and general questions demanded the recall of four pieces of factual information. Retention of factual material was lowest with general questions.

Hunkins (1966), in a study designed to evaluate the relative effects of higher versus lower cognitive-levels of questioning gains on an achievement test, concluded that the employment of higher cognitive-level questions (analysis and evaluation) produce significantly greater scores in social studies achievement than do lower cognitive-level questions (knowledge). For more detail see Chapter III.

The results obtained by Frase (1968d) were contrary to his expectations. He expected general questions, as they required the mental manipulation of more factual information, to result in the retention of more factual material. As Hunkins (1966) did not subdivide the achievement scores by question types, no additional information may be abstracted regarding the effects of higher cognitive-levels of questions upon retention of factual materials to lend support to or refute Frase's (1968d) findings.

Question Pacing

In a study conducted in 1967, Frase varied the length of passages between questions and found, while keeping the total number of questions constant, the effect of question pacing differed for retention of relevant material as opposed to incidental material. A moderate length pas-

sage (approximately 20 lines) was found to be optimal for the retention of relevant material, while retention of incidental questions tended to improve with longer passages. This finding is in accordance with Ausubel's (1963) position concerning meaningful verbal learning. The more the material is broken up by questions, the lower the incidental learning. The results seem to confirm a small step approach for specific retention, and a large step approach for general retention (Frase, 1967, 1968a).

Question Frequency

Rothkopf (1966) stated that shaping of mathemagenic behavior or inspection behavior takes place in segments of material followed by questions and if questions are administered fairly frequently; two treatment questions were inserted every three pages.

Retention of factual material was found to increase with an increase in post-questions, but to decrease with an increase of pre-questions (Frase, 1968a). The reason post-questions work better than pre-questions seem to be that they provide cues for the elicitation or shaping of efficient overall reading behavior; whereas, pre-questions seem to narrow the inspection behavior only to question relevant material. Both effects increase with an increase in questions (Frase, 1968d).

Question Difficulty

Task difficulty effects learning efficiency. Excessively difficult material makes for an undesirably large number of initial errors and misconceptions that have to be unlearned, interferes with necessary intra-task mastery and consolidation in sequential learning programs, and depresses the learner's self-confidence, lowers his motivation, increases his anxiety, and promotes task avoidance. In meaningful problem-solving situations it typically induces perseveration, rigidity, blind trial-and-error, and disorganized behavior (Klausmier and Check, 1962).

Easy items, on the other hand, are also disfunctional in that they seem to instill in the student an unwarranted confidence in his ability to understand or recall a particular bit of information and prompt him to terminate his study prematurely (Ausubel, 1968). Studies by Rothkopf (1965), and Hershberger and Terry (1965) confirm this generalization or rule.

Thus, moderate difficulty seems to induce optimum learning. As moderate defines a range from not too easy and not too hard, greater insight of the relationship between question difficulty and learning gains may be obtained by analyzing the affect of the mean difficulty level for each question type upon learning gains as measured by an achievement test.

Question Mode

A disadvantage of a multiple-choice item is that it may produce different cognitive processes in different individuals. An item may elicit a particular cognitive process if students choose to cope primarily with the stem, then search the alternatives for the most appropriate response. But, the item may not elicit the desired process when the student attempts to solve the item by systematically eliminating distractors which apparently bring other cognitive processes into play (Stoker, 1964). Frase (1968a), however, compared two question modes, multiple-choice to constructed response, and found both response types equal in stimulating retention of factual material from a reading passage.

Knowledge of Results

On theoretical grounds, knowledge of results (KR) or feedback would appear to be an extremely important learning variable. Nevertheless, because of serious gaps and inadequacies in the research evidence, little unequivocal information is available about its actual effects on learning or about its mechanism of action (Ausubel, 1968).

Hershberger (1964) has found feedback facilitates learning and retention where the learner must comprehend and internalize the material presented to him. Frase (1967) found KR to be effective in improving retention only on section of prose directly relevant to factual questions and to be ineffective in improving retention of prose material

incidental to factual questions asked. Although KR is shown to be favorable to learning by both Hershberger and Frase, it is certainly dispensable for either type of learning (Ausubel, 1968).

Summary

Questions and questioning, as a complex function serving many purposes, has long been recognized as an effective learning tool. A great deal of time is spent in every class period using questions, most frequently of the "lower level" requiring memorization and recall. Educationists and psychologists lend support to proper use of questioning technique to guide and develop cognitive skills.

Studies related to questions and questioning in reading show a remarkable similarity in findings. Most of the studies have pursued research using similar kinds of questions, materials, and procedures. The questions have for the most part been of the type which calls for retention of specific details based on a limited amount of reading and on an equally limited amount of information processed.

The application of these research findings must be considered as limited to a rather narrowly conceived and specific kind of learning - reading for details.

Reading for details, however, is but one type of purposeful reading. In spite of the support some educators and psychologists have given to the idea that question

types can guide reading and stimulate thinking, research workers, supervisors, and teachers have been usually slow in conducting studies to show the effects of other question types on learning. Certainly much more research is needed on questions calling for higher level reading-thinking skills.

CHAPTER III

DEVELOPMENT OF PROBLEM

Since questions classified by Bloom's taxonomy are used to assess students' learning gains, and since they are believed to be effective in guiding learning behavior, the structure of the taxonomy is important in the development of the problem. For this reason a brief description of the taxonomy will be given.

Bloom's taxonomy has two major divisions: knowledge, and intellectual skills and abilities. Within the two major divisions six cognitive processes are organized from least to most complex:

major divisions:	cognitive processes:
knowledge (facts)	knowledge
	comprehension
	application
intellectual skills (thinking)	analysis
	synthesis
	evaluation

The mental activities defined within each cognitive process are (Tyler and Okumu, 1965):

I. Knowledge: the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure or setting.

Subclasses: knowledge of terminology, knowledge of specific facts, knowledge of conventions, knowledge of trends and sequences, knowledge of classifications and

categories, knowledge of criteria, knowledge of methodology, knowledge of principles and generalizations, knowledge of theories and structures.

II. Comprehension: understanding or apprehension such that the individual knows what is being communicated and can make use of the material or idea without necessarily relating it to other material or seeing its fuller implications.

Subclasses: translation, interpretation, extrapolation.

III. Application: the use of abstractions in particular and concrete situations.

Subclasses: none.

IV. Analysis: the breakdown of a communication into its constituent elements or parts such that the relative hierarchy of ideas is made clear and/or the relations between ideas expressed are made explicit.

Subclasses: analysis of elements, analysis of relationships, analysis of organizational principles.

V. Synthesis: the putting together of elements or parts so as to form a whole.

Subclasses: production of a unique communication, production of a plan or proposed set of operations, derivation of a set of abstract relations.

VI. Evaluation: judgments about the value of material and methods for given purposes.

Subclasses: judgment in terms of internal evidence, judgment in terms of external criteria.

The six cognitive processes are purported to be hierarchical and cumulative; hierarchical in that the cognitive processes are arranged from least to most complex, and cumulative in that the simpler behaviors are viewed as components of the more complex behaviors. With each level the cognitive processes are assumed to be the same and are used as manipulators of the subject matter or content. The subject matter or content is considered to be irrelevant to the structure of the taxonomy (Bloom, 1956).

Hunkins (1966), using Bloom's taxonomy to categorize questions into higher and lower cognitive levels, used question types as the independent variable in a study to measure the learning effects of responding to a higher or lower cognitive level question. Two hundred and sixty subjects of a northeastern Ohio community were randomly divided into two groups. The first group responded to knowledge questions and the second group predominantly responded to evaluation questions. For 35 minutes a day for four weeks, pupils were directed to read designated sections of their textbook and to respond to questions on worksheets. At the end of the four-week period an achievement test, composed of 42 multiple-choice items that were divided into six subsets each representing a level of Bloom's taxonomy, was administered with the objective of obtaining a single achievement score. An analysis of covariance was used to analyze the data. From the analysis

conducted, the following conclusion was drawn:

> The employment of high cognitive-level questions (analysis and evaluation) produced significantly greater scores in social studies achievement than did low cognitive-level questions (knowledge).

The conclusion, however, does not seem to be generalizable beyond the set of questions used, because few question variables were controlled. Further, little insight may be deduced as to the cause of results.

Questions or test-like events facilitate learning in two ways: (a) attention-like effects; that is, effects on inspection (study) behavior of students (Rothkopf, 1963, 1965, 1966), and (b) direct instructional effects; that is, questions are informative (Estes, Hopkins and Crothers, 1960; Levine, Leitenberg and Richter, 1964). As questions are informative and as the informative aspect may vary with the question types, it may be possible that the higher level questions, being more informative in Hunkins' (1966) study, resulted in the increased achievement.

This phenomenon is probable since the treatment involved reading textual material and responding to questions for 35 minutes per day for four weeks. After the treatment, an achievement test covering all material read in the last four weeks was administered. As the groups varied only by the set of questions answered, it seems likely that the achievement scores would be dependent upon

the particular set of questions. If the high-level questions were more informative this may increase the achievement score. In any event, it is difficult to deduce whether the difference in achievement scores was due to the difference in the informative aspects between question types, or to the changes in inspection or study behavior induced differentially by question types, or the combination of both.

In order to examine whether the repetitive responding to higher cognitive-level questions improves study and reading behavior which increases achievement, while assuring that the informative aspects of question types does not directly influence achievement; the research design used by Hunkins (1966) requires changes. This may be accomplished by having students respond to a question type after reading textual material, repeating this procedure several times using different reading material, and measuring achievement upon new reading material. A comparison of achievement scores between groups will indicate the relative difference (if any) between groups.

The hypothesized difference in achievement scores is based on the assumption that responding to a unique question type does guide the study and inspection behavior, as well as the cognitive or thinking processes of students. The repetitive responding to a question type is assumed to establish a mental set to a particular learning objective

inherent in the question type. For example, if the objective of a question type repeatedly presented to a student is to recall factual information, the learning task of searching for and memorizing factual information would likely be employed if this type of question is repeatedly presented. On the other hand, if the objective of a question type repeatedly presented to a student is to apply factual information, the learning task of searching for, memorizing, understanding, and applying factual information would probably be employed if this type of question is repeatedly presented. Whichever cognitive skills are employed, they should improve with practise if cognitive processes are skills which are learned.

However, the amount achieved by a student who repeatedly responded to factual questions should be different than the amount achieved by a student who repeatedly responded to application questions. The amount achieved being defined as the subscores on knowledge, comprehension, application, and analysis cognitive-level test items. To examine a possible reason, the theoretical structure of Bloom's taxonomy is related to possible achievement gains.

The cognitive-level processes are believed by Bloom to be the combined sum of lower cognitive-level processes plus a unique process. In order to apply factual information to a new problem-solving situation, a person must contain the information, understand it, in order to

apply it. If this person were given an achievement test consisting of knowledge, comprehension, and application cognitive-level test items, then this person would do well on all three question types. This would seem so if Bloom's taxonomy categorized cognitive processes which were hierarchical and cumulative.

On the other hand, a person who memorized the factual information but did not understand it and was not able to apply it, would only do well on the knowledge cognitive-level test items. But, the person who is able to apply the factual information would score more correct responses on the achievement test than the person who only contained the factual information.

If two students expected to respond to different cognitive-level questions after reading and studying a reading passage, the number of correct responses should be similar to the above example. Thus, it seems that achievement on other cognitive-level questions may be dependent upon the type of question to which a student has been exposed. If a student has responded to knowledge questions and expects to respond to knowledge questions, then his achievement and cognitive skills may develop in accordance with his questioning experience. The student may attack a learning situation with the expectancy of being tested on the factual material within the problem-solving situation. The predominant use of these questions may make the student

more aware of factual information and with time improve his ability to memorize at the expense of not developing higher cognitive processes.

However, if an expectancy is developed for higher cognitive-type questions, and if higher cognitive questions are dependent upon lower cognitive processes, then perhaps thinking and acquiring information need not be separated by using higher cognitive-level questions. For example, the expectation of responding to application-type questions after a learning situation such as a reading task, may result in the memorization of factual knowledge, the comprehension of the material and ideas, and their application to new situations. Thus, the expectancy to respond to higher cognitive questions may result in more mental activities and a greater amount of learning.

In conclusion, achievement seems dependent upon the type of question a student has been exposed to. If this concept can be shown to be true, than perhaps educators should become more conscious of the type of questions used in textbooks and classrooms.

Problem

This study will attempt to determine whether repeated responding to higher cognitive-level questions over a short period of time increases achievement in reading. In other words, does the type of question responded

to after several reading passages tend to increase or decrease the amount learned from a new reading passage.

Limitations of the Study

1. No study has shown that predominant responding to a question type and reinforcing correct answer results in a learning set which affects performance on the question type, as well as performance on other question types. Thus, related studies were used to optimize learning and the development of a learning set.
2. The treatment effect of reading three passages and of responding to the limited amount of 60 multiple-choice questions within a day may not induce any measurable change in students' learning behavior as measured by an achievement test.
3. As the majority of research has concentrated on the effects of factual question upon retention of factual material, with the avoidance of examining the effects of higher-level question types, generalization from studies on factual questions are extended to other question types.

Assumptions

The basic assumptions of this study are: (a) the

content of thinking is diverse--even at six years a child enters school with thousands of memories, precepts, and concepts--but the processes of thinking are few; (b) thinking takes place during learning but is an intervening variable rather than a final product; (c) learning is a cognitive process of improving skill(s) or perfecting the execution of solution(s); (d) different classes of behavioral objectives as defined by Bloom (1956) in "Taxonomy of Educational Objectives" are skills that are learned; (e) the taxonomy is hierarchical in structure; (f) the objectives in one class of Bloom's taxonomy are likely to make use of and are built on the behaviors found in the preceding classes, but the relationship between objectives may not be simply a sum of the lower classes; (g) repetitive responding to a question type, and reinforcing correct responses, will establish a learning set.

CHAPTER IV

METHOD

Design

In order to test the research hypothesis that the repetitive response to a question type influences achievement, the following design outlined by Campbell and Stanley (1966, p. 8) was adopted. This study is classified as a "true experimental design," consisting of "Posttest-Only Control" as shown in Table I.

TABLE I

GROUP DESIGN

groups	sequence	passage 1	passage 2	passage 3	criteria
Control Group	Random				O_c
Knowledge Group	Random	X_1	X_2	X_3	O_c
Comprehension Group	Random	X_1	X_2	X_3	O_c
Application Group	Random	X_1	X_2	X_3	O_c

The following questioning variables are considered to be fixed in the research design of this study: question placement, question frequency, question types, and question pacing.

Test Material

The reading passages and question types were obtained from a three-year study conducted by Kropp, Stoker, and Bashaw (1966). The questions and passages were used to determine the validity of Bloom's taxonomy. The content dealt with in each reading passage is: (a) atomic structure, (b) glaciers, (c) Lisbon earthquake, and (d) economic growth (See Appendix A). With each reading passage, 20 cognitive-level questions were constructed according to each level of Bloom's taxonomy.

This study used only the first four cognitive-level questions as the last two employ the free-response format as compared to the multiple-choice format of the first four levels. As the free-response format may introduce experimental error when compared with the multiple-choice format, the latter two cognitive-level questions were excluded.

The sequence of the items in each test were randomly ordered. The random ordering was done as the knowledge-level questions were sequenced according to the sequence of the reading passage, while the other question types were not (See Appendix B for knowledge type questions, Appendix C for comprehension type questions, and Appendix D for application type questions).

The Lisbon Earthquake was selected as the reading passage on which the achievement test was based. Of the four passages, Lisbon Earthquake was selected because the content was thought to be least known to most students.

The achievement test, based on the material in Lisbon Earthquake, was constructed of 15 randomly selected test items from each of the first four cognitive-level questions. There are 20 test items per question type. The randomly selected test items were randomly sequenced (See Appendix E).

Population and Subgroups

The test sample is arbitrarily divided into two groups: rural and urban. The rural sample represents all Grade XI and XII academic and nonacademic students attending Wainwright High School. The urban sample represents all Chemistry 30 students attending McNally High School in Edmonton. The descriptive statistics for these two groups appear in Table II.

TABLE II

DESCRIPTIVE STATISTICS OF TEST SAMPLE

Urban		Rural	
Males	52	Males	61
Females	25	Females	69
Grade XI	0	Grade XI	67
Grade XII	76	Grade XII	64
Academic	76	Academic	96
Nonacademic	0	Nonacademic	35
Average I.Q.	119	Average I.Q.	109

The test sample of rural and urban students characterizes a hypothetical population. Thus any inference made from this study is made to this hypothetical population.

Statement of Hypothesis

Hypothesis I

Prior repetitive response to higher cognitive-level multiple-choice questions increases learning as measured by an achievement test.

H_0: $U_{CON}(k,c,ap,an) = U_K(k,c,ap,an) = U_C(k,c,ap,an) = U_A(k,c,ap,an)$

H_1: There is a significant difference between control and treatment groups.

Collection of Data

Students were randomly divided into four groups: control, knowledge, comprehension, and application. In the treatment, students were instructed to read and study a reading passage for ten minutes, and then respond to 20 multiple-choice questions. The questions were answered without referring back to the reading passage. A key of the correct responses was provided as feedback of results. Students were asked to enter the number of correct responses at the bottom of the answer sheet. A maximum time of 20 minutes was suggested for reading a passage and answering the questions. This procedure was continued over three reading passages presented randomly to each student. Each student was to respond to 60 questions of one cognitive-level. The allowed treatment was one hour (See Appendix F for instructions).

At the completion of the treatment students read and studied a new passage, Lisbon Earthquake, and responded to an achievement test consisting of 60 questions; 15 questions from each of the four levels:

(k): knowledge

(c): comprehension

(ap): application

(an): analysis

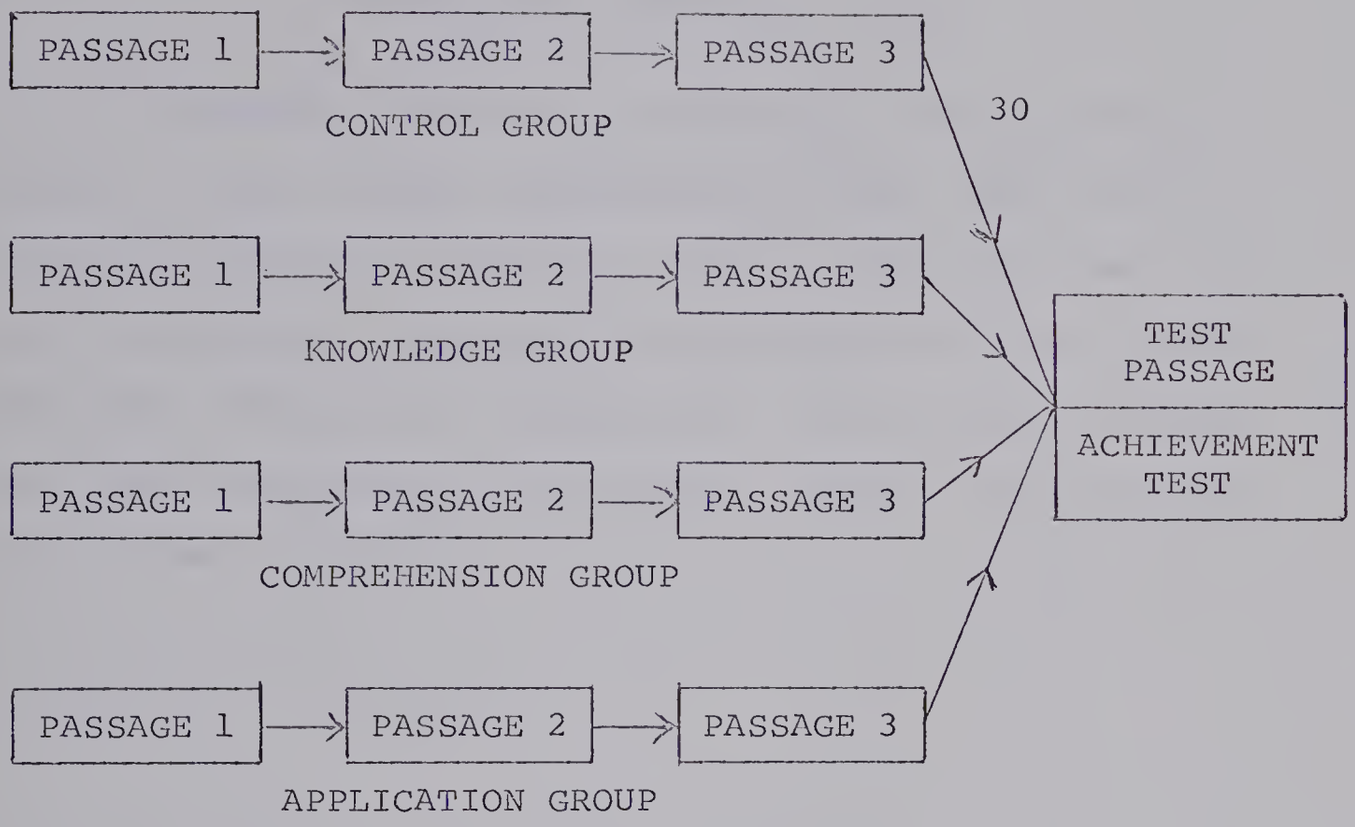
Statistical Model

As the treatment effect is measured by an achievement test with categories possibly differentially correlated, an exact multivariate procedure was used to analyze mean differences. And, as the treatment effects are fixed for each group, no inference will be made beyond the described treatment.

Homogeneity of Intelligence Coefficients

Through the use of randomization the treatment groups are assumed to be equal on prior knowledge, and scholastic ability.

Summary of Treatment



Treatment groups:

Control (CON):	did not respond to questions
Knowledge (K):	responded only to knowledge questions
Comprehension (C):	responded only to comprehension questions
Application (A):	responded only to application questions

CHAPTER V

STATISTICAL RESULTS

Treatment groups are assumed equal on scholastic ability. Based on Rao's approximate F-test, the test of the above assumption indicates that the null hypothesis of equal intelligence regression coefficients would be accepted at the .05 level of signigicance. The groups are therefore equal on scholastic abilities. Consult Table III for multivariate statistics.

TABLE III

HOMOGENEITY OF INTELLIGENCE
REGRESSION COEFFICIENTS

	Know-ledge	Compre-hension	Appli-cation	Analy-sis
Effect Matrix				
Control Group	.1192	.0803	.0140	.0397
Knowledge Group	.0711	.0979	.0399	.0537
Comprehension Group	.0170	.0381	.0341	.0013
Application Group	.1099	.1295	.1011	.0613
Deviation Product Matrix				
Control Group	2308	1423	1031	812
Knowledge Group	1423	1835	935	769
Comprehension Group	1031	935	1510	797
Application Group	812	769	797	1552

Roa's Approximate F Test Using Wilk's Lambda

DF1 = 12, DF2 = 518.9, F-ratio = 1.27, Probability = 0.23

Lambda = 0.92.

Hypothesis I

The testing of hypothesis 1, based on Wilk's Lambda criterion applying Rao's approximate F-test, indicates that the null hypothesis would be accepted at the .05 level of significance. However, as the observed F probability is .08, the analysis does indicate a possible treatment effect. Consult Table IV and Figure I.

TABLE IV

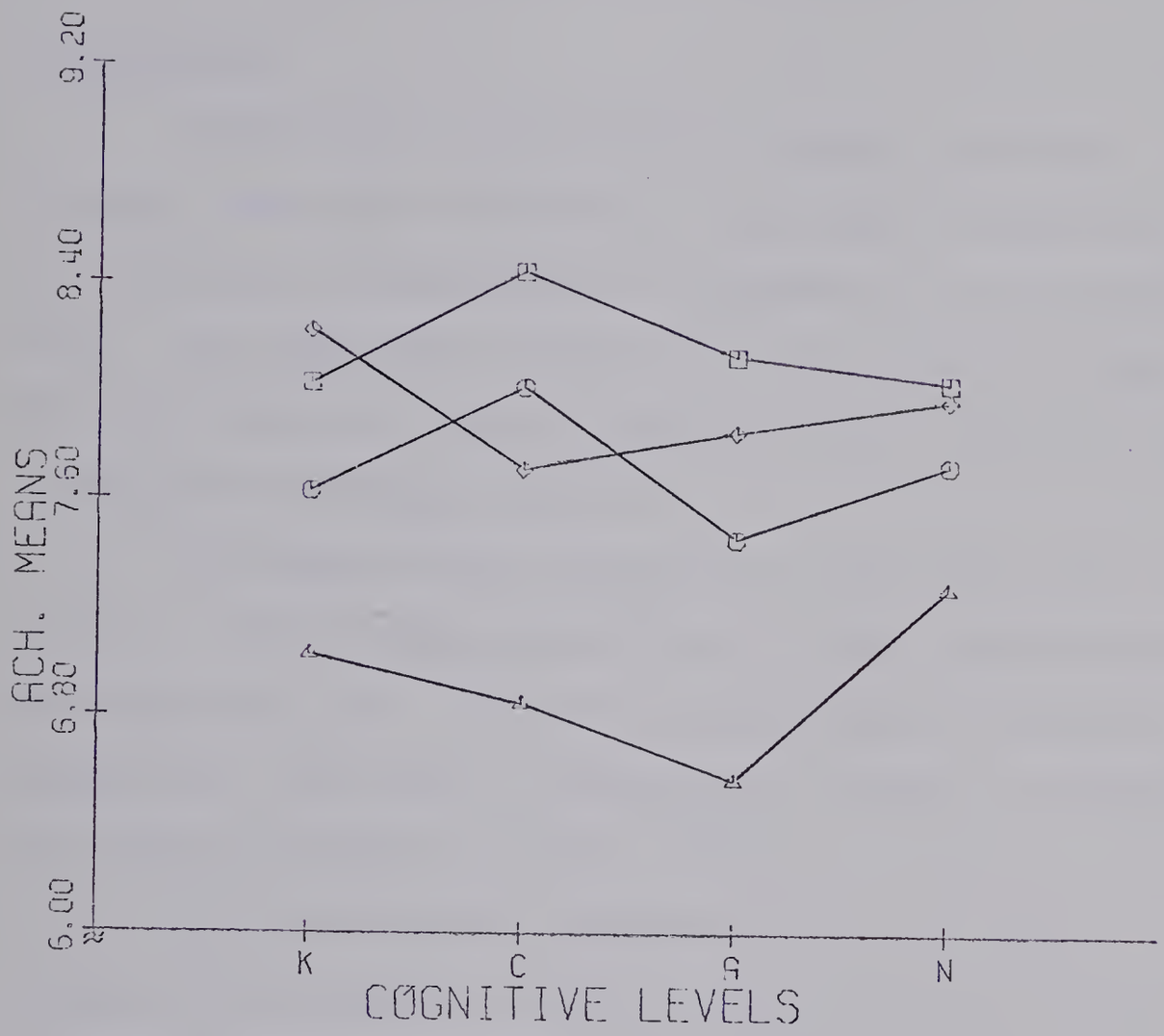
TREATMENT EFFECT

	Know-ledge	Compre-hension	Appli-cation	Analy-sis
Fixed Effects Matrix, Group by Criteria				
Control Group	-0.5220	-0.1099	-0.8460	-0.1048
Knowledge Group	0.5436	0.7117	-0.0113	0.4949
Comprehension Group	0.4524	0.4755	0.6206	0.6239
Application Group	-0.4739	-0.0884	0.2367	-0.0709
Deviation Product Matrix				
Control Group	2526.0	1673.0	1172.0	932.0
Knowledge Group	1673.0	2146.0	1119.0	911.0
Comprehension Group	1172.0	1119.0	1635.0	875.0
Application Group	932.0	911.0	875.0	1625.0

Rao's Approximate F Test Using Wilks Lambda

DF1 = 12.0, DF2 = 529.4, F-ratio = 1.64, Probability = 0.08, Lambda = 0.91.

GROUP VECTOR MEANS



COGNITIVE LEVELS	TREATMENT GROUPS
K - KNOWLEDGE	△ - CONTROL
C - COMPREHENSION	○ - KNOWLEDGE
A - APPLICATION	□ - COMPREHENSION
N - ANALYSIS	◇ - APPLICATION

FIGURE 1

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Repetitive responding to a higher cognitive question type after reading and studying a passage did not increase learning gains as measured by an achievement test. The repetitive responding to one question type therefore does not seem to induce a mental set which alters reading and studying behavior.

The above-stated conclusion is not made with certainty. The obtained probability of equal group means was calculated as .08. Since this probability is close to the pre-set .05 level of significance, there is evidence to suspect possible treatment effects.

The evidence for possible treatment effects becomes more apparent in light of the relatively short treatment effect. Students were allowed one hour for reading three passages and responding to 60 questions. Approximately one-half to two-thirds of the students finished. All students finished the criterion task.

Had all students completed the treatment material, however, the possible treatment effect may have reduced the variation within the four cognitive-level achievement scores.

A slightly reduced error term would have resulted in the rejection of the null hypothesis.

Recommendation

The major weakness of this study is the short treatment effect. Although the administrators, teachers, and students were very cooperative in assisting in this study, it was not possible to obtain students for more than a scheduled 85-minute period. As all students went to different classes based on their individual program, it was impossible to retain the students for a greater length of time without disrupting other classroom activities.

A longer treatment effect is felt to be needed in order to induce studying and reading changes through question types at the .05 level of significance. As the probability of group means being equal was calculated to be .08 when using a short treatment effect, it is recommended that a longer treatment effect be used.

To obtain students for more than 85 minutes does not seem possible; and, if possible, may not be advantageous. To have students perform the same task for more than 85 minutes, to which most students are unaccustomed, may introduce fatigue, and, therefore, error in student's performance.

To eliminate the above problem and to increase the time of treatment, it is suggested that the treatment be extended over four days. The time per day may be reduced to a single 40-minute period. On each of the four days a

student would read and study a passage, and then respond to questions. Each student would respond to one cognitive-level question over the four days. On the fifth day the achievement test could be administered. Additional questions and passages would be needed.

By using a 40-minute period treatment task, all students including the slow readers should have time to finish reading and studying a passage, and answering the questions. Repeating this seems likely to induce changes in reading and studying behavior.

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A P P E N D I X

APPENDIX A

READING PASSAGES USED

ATOMIC STRUCTURE

Directions

This is a test to determine whether questions can guide your learning. You will be asked to read and study a passage called "Atomic Structure" and then you will be asked to answer questions about it. You may not refer to the passage while answering questions.

Your answer must be marked on the answer sheet which has been provided. DO NO MAKE ANY STRAY MARKS. If you make an error, erase it completely before marking your new answer.

MAKE NO MARKS IN THE TEST BOOKLET.

The following is a sample question to show you how your answers are to be marked. Study the sample and if you have any questions raise your hand.

SAMPLE	ON SEPARATE ANSWER SHEET
1. The article you will read is about 1. atomic structure 2. northeast floods 3. last days of World War II 4. the Spanish-American War	1. 1[■] 2[ ] 3[ ] 4[ ] 5[ ]

You should answer as many questions as you can. Do not spend a great amount of time on any one question. If you are in doubt about the answer to a question, the guess.

R.P. Kropp and H.W. Stoker, Editors
Department of Educational Research and Testing
and Institute of Human Learning
Florida State University
Tallahassee

April, 1965

Table 1. Mendeleef 1870

Groups:		I	II	III	IV	V	VI	VII	VIII
Typical Elements:		H Li	Be	B	C	N	O	F	
Periods	Series								
1.	1. 2.	Na K	Mg Ca	Al -	Si Ti	P V	S Cr	Cl Mn	FeCoNiCu
2.	3. 4.	(cu) Rb	Zn Sr	- Y?	- - Zr	As Nb	Se Mo	Br -	RuRhPdAg
3.	5. 6.	(Ag) Cs	Cd Ba	In -	Sn Ce	Sb -	Te -	I -	- - -
4.	7. 8.	- -	- -	- -	- -	- Ta	- W	- -	OsIrPtAu
5.	9. 10.	(Au) -	Hg -	Tl -	Pb Th	Bi -	- U	- -	- - -

Dmitri Mendeleef now arranged the elements into seven groups, starting with lithium (at. wt. 7), and followed by beryllium (at. wt. 9), boron (11), carbon (12), Nitrogen (14), oxygen (16) and fluorine (19). The next element, in the order of increasing atomic weight, was sodium (23). This element resembled lithium very closely in both physical and chemical properties. He, therefore, placed it below lithium in his table. After placing five more elements, he came to chlorine, which had properties very similar to fluorine, under which it miraculously fell in his list. In this way he continued to arrange the remainder of the elements. When his list was completed, he noticed a most remarkable order. How beautifully the elements fitted into their places. The very active metals lithium, sodium, potassium, rubidium and cesium fell into one group (No. I). The extremely active non-metals, fluorine, chlorine, bromine and iodine all appeared in the seventh group.

Mendeleef had discovered that the properties of the elements "were periodic functions of their atomic weights," that is, their properties repeated themselves periodically after each seven elements. What a simple law he had discovered! But here was another astonishing fact. All the atoms in Group I united with oxygen, two atoms to one. All the atoms of the second group united with oxygen, atom for atom. The elements of Group III joined with oxygen, two atoms to three. Similar uniformities prevailed in the remaining groups of elements. What in the realm of nature could be more simple? To know the properties of one element of a certain group was to know, in a general way, the properties of all the elements in that group. What a saving of time and effort for his chemistry students!

Could his table be nothing but a strange coincidence? Mendeleef wondered. He studied the properties of even the rarest of the elements. He re-searched the chemical literature list he had, in the ardor of his work, misplaced an element to fit in which his beautiful edifice. Yes, here was a mistake! He had misplaced iodine, whose atomic weight was recorded at 127, and tellurium, 128, to agree with his scheme of things. Mendeleef looked at his Periodic Table of the Elements and said that it was good. With the courage of a prophet, he made bold to say that the atomic weight of tellurium was wrong; that it must be between 123 and 126 and not 128, as its discoverer had determined. Here was downright heresy, but Dmitri was not afraid to buck the established order of things. For the present, he placed the element tellurium in its proper position, but with its false atomic weight. Years later his action was upheld, for further chemical discoveries proved his position of tellurium to be correct. This was one of the most magnificient prognostications in chemical history.

Perhaps Mendeleef's table was now free from flaws. Again, he examined it, and once more he detected an apparent contradiction. Here was gold with the accepted atomic weight of 196.2 placed in a space which rightfully belonged to platinum, whose established atomic weight was 196.7. The fault-finders got busy. They pointed out this discrepancy with scorn. Mendeleef made brave enough to claim that the figures of the analyst, and not his table, were inaccurate. He told them to wait. He would be vindicated. And again the balance of the chemist came to the aid of the philosopher, for the then-accepted weights were wrong and Mendeleef was again right. Gold had an atomic weight greater than platinum. This table of the queer Russian was almost uncanny in its accuracy!

Mendeleef was still to strike his greatest bolt. Here were places in his table which were vacant. Were they always to remain empty, or had the efforts of man failed as yet to uncover some missing elements which belonged in these spaces? A less intrepid person would have shrunk from the conclusion that this Russian drew. Not this Tartar, who would not cut his hair even to please his Majesty, Czar Alexander III. He was convinced to the truth of this great generalization, and did not fear the blind, chemical skeptics.

Here in Group III was a gap between calcium and titanium. Since it occurred under boron, the missing element must resemble boron. This was his eka-boron which he predicted. There was another gap in the same group under aluminum. This element must resemble aluminum, so he called it eka-aluminum. And, finally he found vacant space between arsenic and eka-aluminum which appeared in the fourth group. Since its position was below the element silicon, he called it eka-silicon. Thus he predicted three undiscovered elements, and left it to his chemical contemporaries to verify his prophecies. Not such remarkable guesses after all--at least not to the genius Mendeleef!

Mendeleef had made places for more than sixty elements in his Table. Three more he had predicted. What of the other missing building blocks of the universe? Twenty-five years after the publication of Mendeleef's Table, two Englishmen, following the clue of Cavendish, came upon a new group of elements of which even the Russian had never dreamed. These elements constituted a queer company--the Zero Group, as it was later named. Its members, six in number, are the most unsociable of all the elements. Even with that ideal mixer, potassium, they will not unite. Fluorine, most violent of all the non-metals cannot shake these hermit elements out of their inertness. Moissan tried sparking them with fluroine, but failed to make them combine. Besides, they are all gases, invisible and odorless. Small wonder they had remained so long hidden.

Besides these six Zero elements, seventeen other elements were unearthed, so that, a year after Mendeleef died in 1907, eighty-six elements were listed in the Periodic Table. Table 1 shows Mendeleef's table in 1870.

Two years after Mendeleef was laid beside the grave of his mother and son, Pattison Muir declared that "the future will decide whether the Periodic Law is the long looked for goal, or only a stage in the journey; a resting place while material is gathered for the next advance."

History has shown that the Periodic Law weathered time beautifully. Throughout the years the current Periodic Table has had many similarities to Mendeleef's table. Table 2, the current periodic table, reflects one major change. For many years the atomic weights of elements have been based on the weight of oxygen - 16.000; this table (Table 2) is based on the weights of carbon - 12.000.

Current Periodic Tables, such as Table 2, are built on the concept of atomic number rather than atomic weight. The present Periodic Law can be stated thusly: The properties of the elements are periodic functions of the atomic numbers. Table 2 makes use of this concept and also uses the concept of increasing energy. To illustrate: In Table 2, oxygen (O) - at. wt. = 16.0; at. no. = 8; Group = VI. We now see that every atom has associated with it a characteristic atomic number and a characteristic atomic weight.

The atomic weight of an atom is the total weight of its parts which are protons, electrons, and neutrons. Each proton has a weight of one (1); each electron has a weight of zero (0); and each neutron has a weight of one (1). The reason the table based on atomic weight and the table based on atomic number are similar is that the atomic number is equal to the number of protons in an atom.

In addition to weight, the parts of an atom have characteristic electrical charges. Protons are positive (+), electrons are negative (-), and neutrons are neutral (0). In every element there are equal numbers of protons and electrons. There are situations when an atom does not have equal numbers of electrons and protons; when this occurs, the atom is called an ion.

Characteristics of the Particles of an Atom

Particle	Weight	Charge
Proton	1	+1
Electron	0	-1
Neutron	1	0

STAGES OF ECONOMIC GROWTH

Directions

This is a test to determine whether questions can guide your learning. You will be asked to read and study a passage called "Stages of Economic Growth" and then you will be asked to answer questions about it. You may not refer to the passage while answering questions.

Your answer must be marked on the answer sheet which has been provided for you. Use only the special pencil that has been provided. DO NOT MAKE ANY STRAY MARKS. If you make an error, erase it completely before marking your new answer.

MAKE NO MARKS IN THE TEST BOOKLET.

The following is a sample question to show you how your answers are to be marked. Study the sample and if you have any questions raise your hand.

SAMPLE	ON SEPARATE ANSWER SHEET
1. The article you will read is about 1. the stages of economic growth 2. the Boxer Rebellion 3. The Seven Years War 4. The Spanish-American War	1. 1 2 3 4 5

You should answer as many questions as you can. Do not spend a great amount of time on any one question. If you are in doubt about the answer to a question, then guess.

R.P. Kropp and H.W. Stoker, Editors
Department of Educational Research and Testing
and Institute of Human Learning
Florida State University
Tallahassee

April, 1965.

STAGES OF ECONOMIC GROWTH

In several magazine articles and in one book, W.W. Rostow stated that it is possible to identify each nation, with respect to its economic development, as lying in one of five categories:

(1) The traditional society
(2) The precondition for take-off
(3) The take-off
(4) The drive to technological maturity
(5) The age of high mass-consumption

The basic principle of his theory is that, at any given time in an economy, the rapid rate of growth in a relatively few leading industries contributes toward maintaining the over-all strength of that economy. Rostow considers economic change to be a result of political and social as well as economic forces. Pursuing this thought further, Rostow quotes Keynes' dictum: "If human nature felt no temptation to take a chance, no satisfaction (profit apart) in constructing a factory, a railway, a mine or a farm, there might not be much investment merely as a result of cold calculation."

The Traditional Society

The main economic fact about the first stage, traditional society, is the existence of a ceiling on the level of attainable production per head. This ceiling stems from the fact that the potentialities which flow from modern science and technology either are not available or are not applied in a regular fashion. Traditional societies undergo constant change in production due to harvests, plagues, discoveries of new crops and so on. Varying degrees of manufacture develop and agricultural activity rises with improvements like irrigation, but production is still limited by the inaccessibility of modern science and the lack of a systematic understanding of the physical environment capable of making invention a regular flow.

The traditional society is basically agricultural with food production typically absorbing 75% or more of the working force. From this situation follows a social structure which thwarts a man's attempts toward improving his lot in life. Wealth and power are concentrated in the hands of those who control the land, with the real political power tending to lie in the regions rather than in the central government. Clan and family ties play a significant role.

The Pre-Condition for Take-off (Transitional Period)

The second state, the precondition for take-off, is also referred to as the transitional period. Usually, this period begins as a result of aggression by more advanced societies. Essentially, the difference between the traditional society and a more modern society is related to the rate of investment. The traditional society's rate of investment is low (under 5% national income) in comparison to its rate of population increase.

To get the rate of investment up, three sectors--agriculture, export, and social overhead--of the economy are particularly important.

Agriculture--An increased food supply is required to meet the likely rise in population and the growing urban population. Agriculture must help meet the foreign exchange bill for capital development. This can be done directly by selling surplus abroad or indirectly by reducing food imports. Rising farm income must furnish taxes to finance governmental functions and farm surplus income must be controlled by men who will invest in trade and industry and who will reinvest their profits as productivity rises.

Exports--Exports can provide a quick source of money for investment in industry. It takes time for industry to gather strength and there are big bills to pay; therefore, a good part of the investment money must come from rapid increases in production and exportation. Quick-yielding changes in productivity can most readily be applied to the extraction and processing of natural resources.

Social overhead capital--Large outlays must be made for education, transportation, sources of power, and the like. Such investments require a relatively long time for pay-off, require large sums of money, and generally benefit the community as a whole. This indicates that government must generally play an important role in the process of providing money for social overhead. In fact, the most important precondition for take-off is often political. An effective government must maintain a tax and fiscal system which directs resources into modern uses and it is likely that only a vigorous central leadership can achieve this.

When the period of transition has begun, new types of enterprising men come forward and show an ability to raise money and a willingness to take risks in pursuit of profit or modernization. Banks appear, investment increases, and modern factories spring up. The people learn to operate a constantly changing economic system and come to accept progress as not only possible, but necessary. This activity may proceed, however, at a limited pace within a society mainly characterized by tranditional, low productivity methods, and by the old social-political values and structures.

The Take-off

In the third stage, take-off, old resistance to steady growth is overcome and growth becomes the normal condition. Take-off is concentrated within two or three decades and its beginning can usually be traced to some sharp stimulus; for example, a political revolution, a technological improvement, a newly favorable international environment, or a shift to a very unfavorable position in terms of world trade. The most powerful single initiator of take-offs has been the railroad, which has performed the vital tasks of lowering internal transportation costs, developing a new expert sector, and leading toward development of coal, iron, and engineering industries.

The following conditions are required for take-off: (a) a rise in the rate of productive investment to at least 10% of national income, (b) the development of one or more substantial manufacturing industries with a high rate of growth, and (c) the existence or quick emergence of a political, social, and institutional framework so developed as to keep up a continued growth. This further implies a capacity for raising money from domestic sources.

The take-off usually witnesses a social, political, and cultural victory for those who favor modernization of the economy over those who would either cling to the traditional society or seek other goals. New industries expand rapidly, encouraging still other industries, and increasing income in the hands of those who reinvest in the economy.

Drive to Technological Maturity

About forty years after a society ends take-off, technological maturity is usually achieved. During this drive to maturity, the make-up of the economy changes constantly as technology improves. The economy finds its place in international trade. Goods formerly imported are produced at home. New import requirements develop along with new export commodities. Old industries level off and new industries accelerate, often with a shift toward more complex processes such as machine tools, chemicals, and electrical equipment. Thus, maturity is attained when an economy demonstrates its capacity to move beyond the original industries which powered its take-off and apply modern technology to virtually the whole range of its resources.

Three important non-economic aspects accompany the development of a maturing society.

First, the working force changes in composition, in real wages, in outlook, and in skills. By maturity, the percentage of the working force in agriculture has dwindled to a figure as low as 20% in many classes. Not only does the urban population grow, but also there is generally an increase in the proportion of white collar workers, highly trained technicians, and semi-skilled workers. These people realize that they can exert power, by organizing, to achieve higher real wages and greater security; hence, the process of moving toward maturity generates social and political pressures which lead toward humane modifications of the process.

Second, the character of the leadership changes from the industrial tycoon to the efficient professional manager of a highly bureaucratized machine.

Third, the society as a whole takes for granted the miracle of industrialization and begins to question the merits of industrialization as an overriding objective. These changes pose new questions concerning future objectives.

High Mass-Consumption

In the final stage, the age of high mass-consumption, the society has ceased to accept the extension of modern technology as a primary objective. Real income per person increases and so does the effective demand for the products of a mature economy. Each society which has attained this stage of development has struck a unique balance, determined by geography, resources, values, and political leadership, among three broad objectives; (a) the pursuit of external power; (b) the welfare state with a good deal of social legislation designed to redistribute income, to decrease working hours, and to increase social security in general; and (c) the expansion of consumer goods distribution.

Since growth normally proceeds by geometric progression, similar to a savings account if interest is left to compound with principal, the era of high mass-consumption will continue to gather momentum and vary its patterns.

GLACIERS

Directions

This is a test to determine whether questions can guide your learning. You will be asked to read and study a passage called "Glaciers" and then you will be asked to answer questions about it. You may not refer to the passage while answering questions.

Your answer must be marked on the answer sheet which has been provided for you. Use only the special pencil that has been provided. Do not make any stray marks. If you make an error, erase it completely before making your new answer.

MAKE NO MARKS IN THE TEST BOOKLET.

The following is a sample question to show you how your answers are to be marked. Study the sample and if you have any questions raise your hand.

SAMPLE	ON SEPARATE ANSWER SHEET
1. The article you will read is about 1. glaciers. 2. chemistry. 3. glass-blowing. 4. the Spanish-American War.	1. 1[■] 2[ ] 3[ ] 4[ ] 5[ ]

You should answer as many questions as you can. Do not spend a great amount of time on any one question. If you are in doubt about the answer to a question, then guess. Remember that you may not refer to the reading passage at any time during the test.

R.P. Kropp and H.W. Stoker, Editors
Department of Educational Research and Testing
and Institute of Human Learning
Florida State University
Tallahassee

April, 1965

GLACIERS

Ice plays a critical role in the water economy of the earth. About 86 per cent of it is in the Antarctic, where it exerts a profound influence on the weather in all parts of the world.

By William O. Field

Water is one of the few substances on earth existing in nature in all three physical states--liquid, solid, and gaseous. Altogether our planet contains some 350 million cubic miles of water, most of it, of course, in the oceans. Of the earth's total water budget, not much more than one per cent is in the solid form of ice or snow, and far less than that in the form of water vapor in the atmosphere. Yet these proportions make up a delicate balance which is immensely important to life on the earth. Any appreciable change in the ratios of water, ice and atmospheric moisture would have catastrophic consequences for man and his economy. The ice piled in glaciers on the lands, for instance, exercises a vital control over sea levels, climate and the continents' water supplies.

Glaciers now cover about ten per cent (nearly six million square miles) of the world's land area. Our estimate of the total amount of water in them is only a rough guess, mainly because we have only a hazy notion of the thickness of the Antarctic ice sheet. This vast icecap accounts for about 86 per cent of the world's glacial area. The Greenland icecap makes up another ten per cent. The remaining four per cent is not minor, as far as its effects go, for it includes tens of thousands of square miles of glaciers on mountains in the temperate zones, where they intimately influence man's climate and water supplies.

Estimates of the total volume of water in the world's glaciers range from about 2.4 million to more than six million cubic miles. If all this ice melted, the level of the world's oceans would rise by something like 65 to 200 feet!

Glaciers can grow only in areas where the snowfall is great enough year after year to exceed the annual rate of melting. Consequently, the ice sheet is not necessarily thickest where the climate is coldest. In Alaska the greatest concentration of glaciers is along the southern coast, which is the warmest part of the Territory but has the heaviest winter snowfall. Parts of northern Greenland are barren of glaciers because there is not enough snowfall.

As snow accumulates, the pressure of the mountainous layers compacts it into ice. Under its own weight ice begins to flow to lower elevations. The rate of flow of glaciers varies tremendously: some move very slowly while others slide as much as 50 feet per day during the summer. At the lower elevations, the glacier melts or discharges icebergs into the sea. But under suitable conditions, the glacier front may advance over the land year after year. It takes only a slight change in the combination of annual snowfall, melting-season temperatures and other meterological conditions to produce an advance or retreat of a glacier.

Probably during most of the earth's history it has been free of glaciers. We are in an exceptional era--neither glacial nor nonglacial. During the last million years there have been at least four great ice ages; at their maximum, ice covered about 32 per cent of the world's land surface. The ice ages were separated by long warm intervals during which the glaciers nearly disappeared. At present we seem to be in an in-between stage, somewhere between a glacial and an interglacial age. Some glaciers are growing; others are disappearing.

During the last Ice Age the sea level probably was more than 300 feet lower than now. Over the world the temperatures averaged 7 to 14 degrees colder. There were five continental ice sheets of more than one million square miles each. Three of these, in North America, Europe and Siberia, have disappeared, but the two in Greenland and Antarctica remain. Mountain glaciers have all shrunk.

Human civilizations began to arise in Western Asia and North Africa just as the European and North American sheets were disappearing. About 3000 B.C. the climate in many, if not all, parts of the world was drier and warmer by two or three degrees than at present. The sea level was apparently five to six feet higher. The glacial region in the Alps was at least 1,000 feet higher than today. Ice in the Artic Ocean probably melted completely each summer. Parts of the temperature regions where small mountain glaciers now furnish the summer water supply must have been arid.

Conditions began to change drastically about 1000 B.C. The climate became colder and more stormy in many parts of the world, and by about 500 B.C. glaciers began to grow again. Then, in the first millennium of the Christian era, came a period of glacier recession. After that glaciers advanced again to a maximum in the 17th to 19th centuries. This resurgence of glaciers was noted directly by observers in the Alps, Scandinavia and Iceland. Since the latter half of the 19th century, glaciers throughout the world have tended to shrink once again. As a result the sea level has apparently been rising recently at the rate of approximately 2.5 inches per century. Some glaciers, however, have advanced, contrary to the general trend. In parts of the western U.S. there is a growth of glaciers at present which may indicate a changing climate.

Glaciers have been studied seriously for a little more than 100 years. Beginning in 1919 Hans Wison Ahlmann of the University of Stockholm (now Sweden's Ambassador to Norway) introduced a new era in glaciology. He took a new look, in greater detail, at glaciers in Scandinavia, Iceland, Spitsbergen and northeast Greenland, and his examination led to new methods of measuring their nourishment and wastage. Observations of glaciers are now being made on a systematic basis in several parts of the world. During the last decade, important studies have been carried out in Greenland, especially by Paul Victor's French Polar Expeditions, which determined the volume of the Greenland ice sheet and studied its regimen over a broad area.

The little-known Antarctic ice sheet is more than one and a third times the size of the U.S. and its territories. It covers practically the whole continent of Antarctica. Fully three million square miles of the continent have never been seen even from the air. The continent's icecap is known to rise as high as 10,000 feet, but the thickness of the ice has been measured in only a few places.

THE LISBON EARTHQUAKE

Directions

This is a test to determine whether questions can guide your learning. You will be asked to read and study a passage called "The Lisbon Earthquake" and then you will be asked to answer questions about it. You may not refer to the passage while answering questions.

Your answer must be marked on the answer sheet which has been provided for you. Use only the special pencil that has been provided. Do not make any stray marks. If you make an error, erase it completely before marking your new answer.

MAKE NO MARKS IN THE TEST BOOKLET.

The following is a sample question to show you how your answers are to be marked. Study the sample and if you have any questions raise your hand.

SAMPLE	ON SEPARATE ANSWER SHEET
1. The article you will read is about the 1. Lisbon Earthquake 2. Northeast Floods 3. Last days of World War II 4. Spanish-American Way	1. 1 2 3 4 5

You should answer as many questions as you can. Do not spend a great amount of time on any one question. If you are in doubt about the answer to a question, then guess. Remember that you may refer to the reading passage at any time during the test.

R.P. Kropp and H.W. Stoker, Editors
Department of Educational Research and Testing
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April, 1965

THE LISBON EARTHQUAKE

Some catastrophes demand of man far more than relief and rehabilitation: they literally call for rethinking on a universal scale. This was so with the man-made disaster of Hiroshima. Similarly, the great earthquake at Lisbon on November 1, 1755, shook the minds of men.

While controversy surrounds most statistics dealing with the Lisbon earthquake, there is little doubt that it is one of the most severe recorded, Voltaire's classic description in the story, Candide, vividly paints the tragic scene after the earth started to tremble under the feet of the people of Lisbon: "The sea rose in foaming masses in the port and smashed the ships which rode at anchor. Whirlwinds of flame and ashes covered the streets and squares; the houses collapsed, the roofs were thrown upon the foundations, and the foundations were scattered; thirty-thousand inhabitants of every age and both sexes were crushed under the ruins."

In all, there were three shocks. The first, which lasted two minutes, shook the earth so slightly that an eyewitness recalled that he thought it had been caused by a passing vehicle. Two minutes later a second quake was felt, and this time its violence left no doubt as to what it was. During its ten minute visitation of terror, the dust from falling buildings was so great it obscured the sun. Next came another awful tremor, and the buildings which still remained standing now came tumbling down, bringing added dust, and plunging the city into total darkness. After twenty minutes of death-spelling noises, all became quiet. Then, to quote an eyewitness, "a very boisterous (stormy) wind suddenly arose, fanning the flames of the candle-fed fires which had broken out all over the city.

Unfortunately, a combination of circumstances made the disaster greater than it might otherwise have been. For one thing, the quake occurred on All Saints' Day, which meant that candles had been burning since early morning in homes and churches. Then, to make matters worse, the earthquake struck at a bad time: shortly before ten in the morning--an hour when most of the people were at church. The violent movements of the earth caused the roofs of heavy stone to topple on the congregants, who, if they were not crushed to death, died in the flames.

The people experienced all the possible elements of horror. To falling stones and fires must be added the forty foot tidal wave which engulfed those who rushed to the quays after having escaped the earlier shocks. Furthermore, man, or at least a lower species, contributed looting and murder to the scene of despair. Valuable records, irreplaceable documents were lost, and, since there exists no inventory of Lisbon's art treasures of that time, we cannot even guess what the world has lost.

The older, medieval section of Europe's westernmost capital was completely destroyed. So, for that matter, were the towns within a distance of 20 leagues. "I write to you from the depths of the country," complained a survivor, "for there is not a habitable house left. Lisbon has vanished!" Built on a more substantial foundation of basalt, the newer section of Lisbon survived the earthquake.

The Lisbon earthquake, whose tremors were reportedly felt as far north as Norway and as far south as North Africa, made a profound impression on Europe. Great Britain was the first to offer help. Parliament voted the then tremendous sum of one hundred thousand pounds to aid the victims, in addition to gifts of food and clothing. Spain changed her tariff laws to favor Portugal's recovery. Also, large sums of money and provisions from all over Europe were generously offered by sympathetic nations and individuals.

Like today's moral and intellectual repercussions from man-made disastrous weapons, Lisbon's disaster registered severely on the mental seismographs of some of the outstanding thinkers of the eighteenth century. A noted historian of Portugal declares that to the little country on the Iberian Peninsula, the earthquake was "more than a cataclysm (disaster) of nature; it was a moral revolution."

So shattered was the moral and material structure of Lisbon society that it was seriously proposed that the government be transferred to Rio de Janeiro, the capital of its great colony! Fortunately, the crisis brought to complete power a ruthless, but exceedingly capable dictator, Pombal.

He was appointed Minister of Foreign Affairs and War by King Jose I in 1750 and quickly established himself as a dominant figure in Portuguese politics. The earthquake provided an opportunity for him to obtain complete power. On the day after the earthquake he told the Chief Justice to appoint a special magistrate for each of the twelve wards of the city. These magistrates were given authority to carry out the govenment's emergency directives. Troops were rushed to Lisbon in order to maintain law and order and to assist in clearing up the ruins. Pombal's immediate concern was to prevent a plague; steps were taken to remove the bodies of men and animals from the ruins as quickly as possible, pools of stagnant waters were drained and contaminated food was destroyed. A most urgent matter was providing food and shelter for the survivors. Food centers were established and field kitchens were built. Prices of food and building materials were strictly controlled to prevent profiteering. Steps were taken to prevent looting. On November 4 immediate public execution after a summary trial was ordered for those caught looting the ruins.

Although many of Pombal's reforms were short lived, his great schemes and actual reforms shook Portuguese society loose from its medieval foundations. Starting with physical reconstruction while Lisbon was still smouldering, he built a new and more modern city. Temporary wooden structures were constructed outside the city to provide emergency housing and governmental offices. In early 1756 Pombal ordered unauthorized building in stone or brick stopped and the city was rebuilt according to a master plan. Taxation, civil law and public administration were reformed, new industries were set up, communications were improved, colonial relationships were re-evaluated, and education was revamped. Above all, by his ensuing power conflicts with the nobility and the clergy, Pombal helped Portugal advance on the road to a more modern society.

Meanwhile, elsewhere in Europe numerous accounts of the great earthquake were being published in virtually all languages. More than 20 reports, not including magazine articles, were published in 1755 in England alone! The great philosopher Immanuel Kant took time out from his studies to write a book on the theory of earthquakes. But the intellectual crisis in which Europe was embroiled for almost all the rest of the century took place mainly in France. Basically, the great quarrel of the age concerned the validity of the popular optimistic philosophy (hopeful outlook) of Leibniz, who believed that "What is, is Right," and that this is the "best of all possible worlds."

Leibniz stated that man could have no free will in a perfect world and that "Our world is suited to our desires and appetites." He believed that the world was built on a plan which harmonizes with the moral government of its inhabitants and theorized that the past, present, and future have already been set with as much order and harmony as possible. Leibniz surmised that "the world must be destroyed and repaired by natural means, at such times as the government of spirits may demand it for the punishment of some and the reward of others." He felt that evil tends to evoke a greater good in the long run and maintained, "It is impossible to make the world better than it is, not only as a whole and in general, but also for ourselves in particular."

Voltaire, in his long poem, "The Lisbon Earthquake," vigorously attacked the Leibniz philosophy. He regarded it as unprogressive in that "physical evil deserved man's attention." It was also a cruel dogma, he believed, in that it implied that "your particular misfortune is nothing; it contributes to the universal good." Voltaire expressed faith in progress which, he said, depended upon the good sense of mankind.

Leibniz, however, held that we should be content with the order of the past because it is in conformity with the absolute will of God. Although Leibniz suggested that we should make the future in conformity with the presumed will of God, he cautioned against becoming upset if we were unsuccessful.

Rousseau, in an impassioned refutation (answer), maintained an "all is good" theme. Man must be patient and recognize evil as the consequence of his own nature. Furthermore Rousseau claimed that civilization had corrupted man. Although Rousseau looked to the past and said progress was an illusion, he was later to expound, in his Social Contract, a theory of rule by the consent of the governed and actually advocated revolt by the people if they were unfairly ruled.

In Candide Voltaire, as we know, returned to the fray with slashing attacks on Rousseau and Leibniz for their views concerning human progress. Practically all the philosophers of the eighteenth century took sides in what has been called the "theology of earthquakes." Such was the exchange of arguments, in fact, that the wordy Dr. Johnson complained that he was weary of hearing about the subject.

While no such clear-cut philosophical discussion fills our twentieth century air, we scarcely need be reminded that, once again, recent catastrophes have sent man to meditate on life's eternal questions. Obviously, man is worried about possible misuse of fission and fusion.

In addition, Nature, with her unlady-like hurricanes of recent years, and the devastating floods of the past summer, has intruded into what had begun to seem to many like a man-manipulated world. While we are, today, better equipped for relief and rehabilitation than the Portuguese were two hundred years ago, it is well to remember that as in the case of the Lisbon disaster, the Northeast floods in the United States were not even predicted, much less staved off.

Nature's calamities and their aftermath of re-evaluation are still very much with us.

APPENDIX B

KNOWLEDGE QUESTIONS USED

Table 1. Mendeleef 1870

Groups:		I	II	III	IV	V	VI	VII	VIII
Typical Elements:		H Li	Be	B	C	N	O	F	
Periods 1.	Series 1. 2.	Na K	Mg Ca	Al -	Si Ti	P V	S Cr	Cl Mn	FeCoNiCu
2.	3. 4.	(cu) Rb	Zn Sr	- Y?	- - Zr	As Nb	Se Mo	Br -	RuRhPdAg
3.	5. 6.	(Ag) Cs	Cd Ba	In -	Sn Ce	Sb -	Te -	I -	- - -
4.	7. 8.	- -	- -	- -	- -	- Ta	- W	- -	OsIrPtAu
5.	9. 10.	(Au) -	Hg -	Tl -	Pb Th	Bi -	- U	- -	- - -

TABLE 2.

ELECTRON CONFIGURATIONS of the ELEMENTS

Electrons occupy orbitals up to and including atomic number except where triangular marking (◤) indicates that one outer-shell electron drops back to an unfilled inner orbital.

Non-metals are indicated by bar markings above symbols.

Increasing Energy

	s		p						d										f														
1	1.01 H 1	4.00 He 2																															
2	6.94 Li 3	9.01 Be 4	10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10																									
3	23.0 Na 11	24.3 Mg 12	27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.5 Cl 17	39.9 Ar 18																									
4	39.1 K 19	40.1 Ca 20	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36	45.0 Sc 21	47.9 Ti 22	51.0 V 23	52.0 Cr◤ 24	54.9 Mn 25	55.9 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu◤ 29	65.4 Zn 30															
5	85.5 Rb 37	87.6 Sr 38	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	96.0 Mo 42	99.0 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48															
6	133 Cs 55	137 Ba 56	204 Tl 81	207 Pb 82	209 Bi 83	210 Po 84	210 At 85	222 Rn 86	139 La 57	179 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au◤ 79	201 Hg 80	140 Ce 58	141 Pr 59	144 Nd 60	145 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	163 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
7	223 Fr 87	226 Ra 88							227 Ac 89	104	105	106	107						232 Th 90	231 Pa 91	238 U 92	237 Np 93	242 Pu 94	243 Am 95	245 Cm 96	249 Bk 97	249 Cf 98	253 Es 99	254 Fm 100	256 Md 101	102	103		

Group Numbers	I a	II a	III b	IV b	V b	VI b	VII b	0	III a	IV a	V a	VI a	VII a	VIII		I b	II b	Lanthanides (above) and Actinides
	Representative Elements							Inert Gases	Related Metals									Similar Metals

1. Which element is known as the ideal mixer?

    1. Hydrogen (H, #1)
    2. Oxygen (O, #8)
    3. Flourine (F, #9)
    4. Potassium (K, #19)

NOTE: The symbol (#) is used in several questions in this test. This symbol stands for atomic number.

2. Cobalt (Co) has an atomic weight of

    1. 58.9
    2. 52.0
    3. 83.8
    4. 101.0

3. In Table 2, which of the following symbols is used to indicate a non-metal?

    1. p
    2. arrow
    3. bar
    4. white square

4. In Table 2, astatine (At) is a member of Group

    1. III
    2. IV
    3. V
    4. VII

5. All elements in the same group have similar

    1. atomic weights.
    2. general properties.
    3. atomic numbers.
    4. specific properties.

6. The chemical world has had the advantage of a Periodic Table for approximately how many years?

    1. 50
    2. 100
    3. 150
    4. 200

7. According to the passage, elements that do not combine with any other elements belong to the

    1. Second Group.
    2. Gas Group.
    3. Zero Group.
    4. Metal Group.

8. The Zero Group elements might be described as

    1. elements with atomic weights of zero.
    2. highly active gases.
    3. highly active non-metals.
    4. invisible and odorless gases.

9. In Table 2, which of the following symbols is used to indicate an element in which one outer shell electron drops back to an unfilled inner orbital?

    1. d
    2. triangle
    3. black square
    4. Roman numeral

10. In Table 2, most of the inert gases appear in Group

    1. 0
    2. I
    3. II
    4. VI

11. Neon (Ne) has an atomic number of

    1. 10
    2. 11
    3. 12
    4. 16

12. Mendeleef placed the chemical element sodium (Na) in group

    1. I
    2. II
    3. III
    4. IV

13. In Table 2, rhenium (Re, #75) is a member of Group

    1. III
    2. IV
    3. VI
    4. VII

14. Which pair of elements is in the same periodic group?

    1. Sodium, cesium
    2. Sodium, chlorine
    3. Bromine, rubidium
    4. Oxygen, carbon

15. Iridium (Ir) has an atomic weight of

    1. 186
    2. 190
    3. 192
    4. 195

16. An atom with unequal numbers of protons and electrons is

1. a neutron.
2. an electron.
3. an element.
4. an ion.

17. Mendeleef discovered that the properties of elements

1. were periodic functions of atomic numbers.
2. were periodic functions of their atomic weights.
3. were dependent upon temperature and pressure.
4. could not be ordered.

18. Atoms of which group unite with atoms of oxygen in the ratio of 2 to 3?

1. I
2. II
3. III
4. IV

19. How many elements are in the Zero Group?

1. 3
2. 6
3. 9
4. 17

20. Table 2 indicates that sulphur (S, #16) is

1. a yellow powder.
2. a non-metal
3. a typical element.
4. inert.

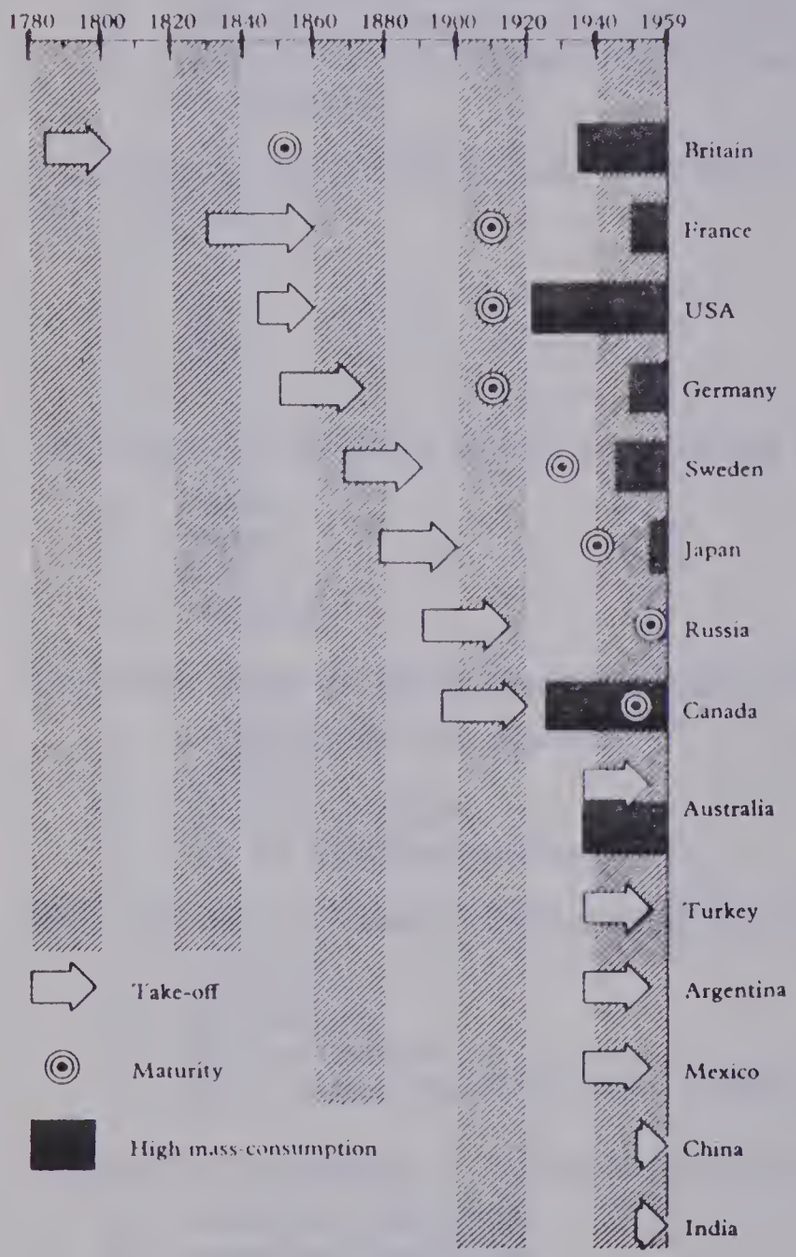

Chart of the stages of economic growth in selected countries. Note that Canada and Australia have entered the stage of high mass-consumption before reaching maturity [By courtesy of the *Economist*]

The length of each arrow indicates the length of the take-off stage.

1. Which of the following is a social overhead expense?

    1. interstate highway
    2. department store
    3. watch factory
    4. farm

2. Which of the following is in the correct order?

    1. take-off, precondition for take-off, drive to maturity
    2. precondition for take-off, take-off, traditional
    3. take-off, drive to maturity, high mass-consumption.
    4. precondition for take-off, high mass-consumption, drive to maturity.

3. The minimum rate of production investment of a country in the off stage is

    1. 5%
    2. 8%
    3. 10%
    4. 20%

4. The Stages of Economic Growth was written by

    1. Keynes
    2. Moore
    3. Rostow
    4. Stolurow

5. The first stage in which growth becomes the normal condition is

    1. precondition for take-off
    2. take-off
    3. drive to maturity
    4. age of high mass-consumption

6. What has been the most powerful single starter of the take-off stage?

    1. railroads
    2. agriculture
    3. complex industries
    4. coal, iron, and engineering industries

7. Productive investment is measured as a percentage of

    1. industrial earnings
    2. government earnings
    3. national income
    4. farm income

8. According to the chart, in 1850 Britain was in what stage?

    1. traditional
    2. take-off
    3. maturity
    4. high mass-consumption

9. Economic growth usually progresses

    1. geometrically.
    2. arithmetically.
    3. logarithmically.
    4. inversely.

10. The stage of development which frequently begins as a result of aggression is

    1. precondition for take-off
    2. take-off
    3. drive to technological maturity
    4. age of high mass-consumption

11. Which stage of growth is a nation's rate of investment under 5% of its national income?

    1. traditional
    2. take-off
    3. drive to technological maturity
    4. age of high mass-consumption.

12. About how many decades does the take-off stage usually last?

    1. one
    2. two or three
    3. four or five
    4. between five and ten

13. How many years does it usually take a nation to achieve maturity after it enters drive-to-maturity?

    1. 20
    2. 30
    3. 40
    4. 60

14. Approximately what per cent of the labor force of a traditional society does work related to agriculture?

    1. 20
    2. 35
    3. 50
    4. 75

15. Which of the following is most likely to produce quick-yielding changes in productivity?

    1. building a hydroelectric plant
    2. manufacturing raw steel products
    3. manufacturing heavy equipment
    4. processing natural resources

16. According to the chart, in 1959 India was in what stage?

    1. traditional
    2. precondition for take-off
    3. take-off
    4. maturity

17. Which stage of development is also known as the traditional period?

    1. traditional
    2. precondition for take-off
    3. take-off
    4. drive to technological maturity

18. According to the article, how many stages of economic growth are there?

    1. 3
    2. 5
    3. 7
    4. 10

19. According to the chart, in which stage was Canada during the period 1900-1910?

    1. traditional
    2. take-off
    3. maturity
    4. high mass-consumption

20. Rostow considers economic change to be the result of

    1. economic and social forces.
    2. economic and political forces.
    3. economic, political and social forces.
    4. "cold calculation" alone.

Table 1. Distribution of Water Volume

LOCATION	CUBIC MILES
Water in the oceans (close estimate)	329,000,000
Water in the atmosphere (rough estimate)	3,600
Water in glaciers (average of high and low estimates)	4,200,000
Water in lakes and rivers (rough estimate)	55,000
Ground water above 12,500 feet (very rough estimate)	1,080,000
Ground water below 12,500 feet (very rough estimate)	19,700,000

Table 2. Distribution of Ice by Area

LOCATION	SQUARE MILES
Africa	8
Antarctica	5,019,000
Asia	42,200
Canadian Arctic Islands	45,000
Europe	4,370
Greenland	666,300
North America	30,890
Northern Atlantic and European Arctic Islands	45,400
Pacific Islands	392
South America	9,650
Sub-Antarctica Islands	1,160
World Total	5,864,370

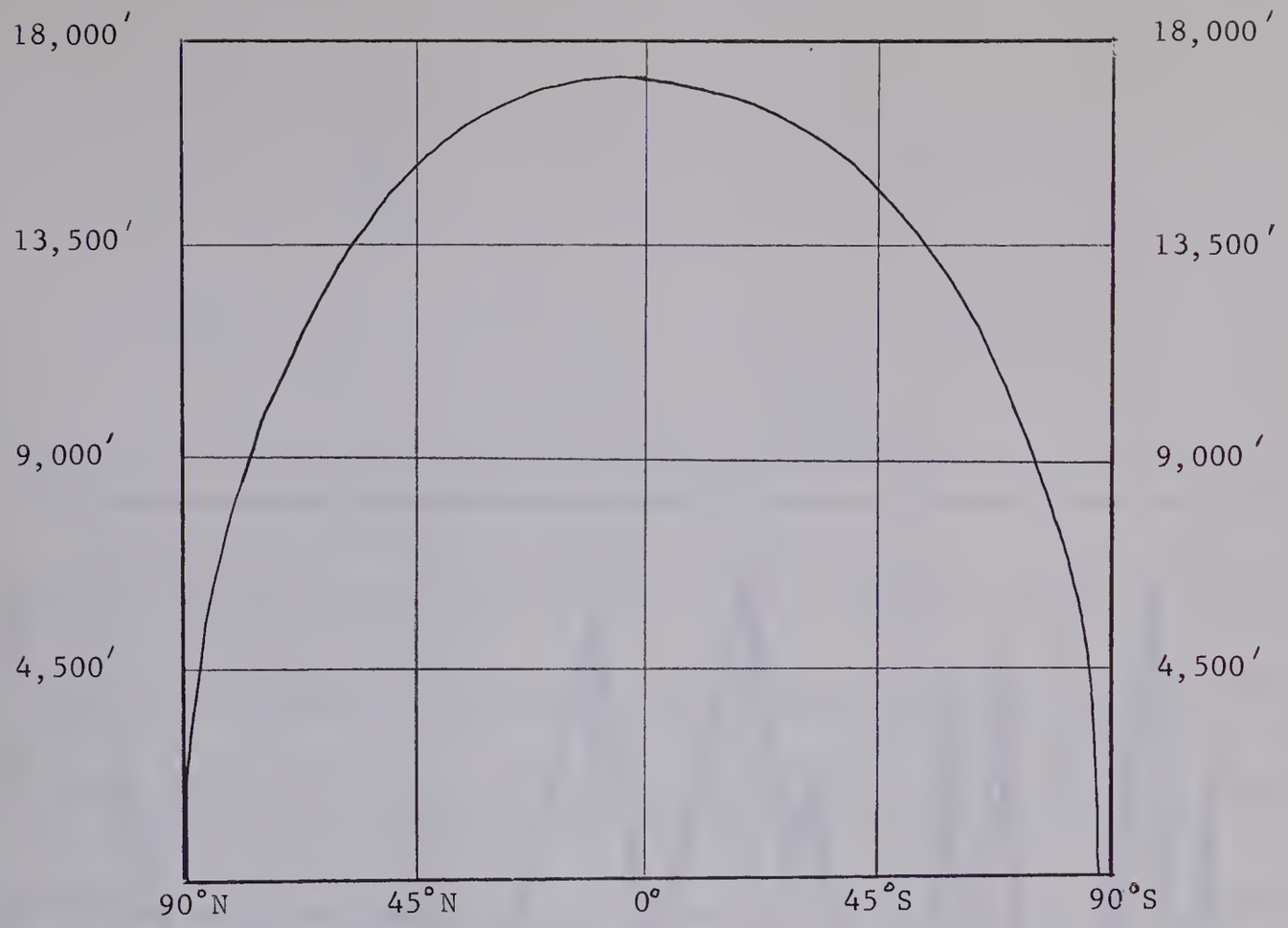

FIGURE 1. Approximate height of snow at various latitudes.

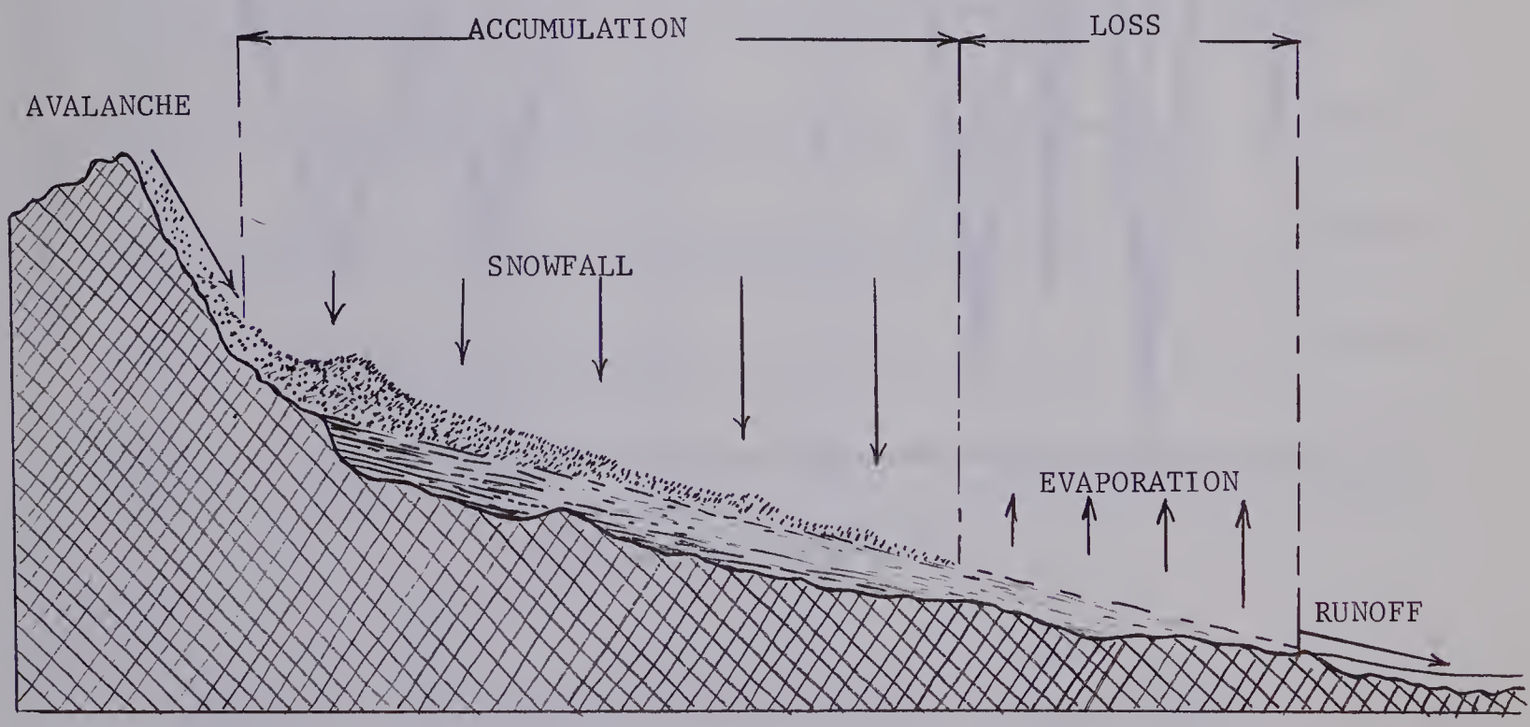

Figure 2. LIFE OF A GLACIER is depicted in this cross section of an ideal valley glacier. Falling snow carried by avalanche is compressed into ice, which begin to move by its own weight. The line dividing the areas of accumulation and loss is the firn line, where total accumulation equals total melting. Variations in snowfall, temperature and other conditions determine whether the glacier advances.

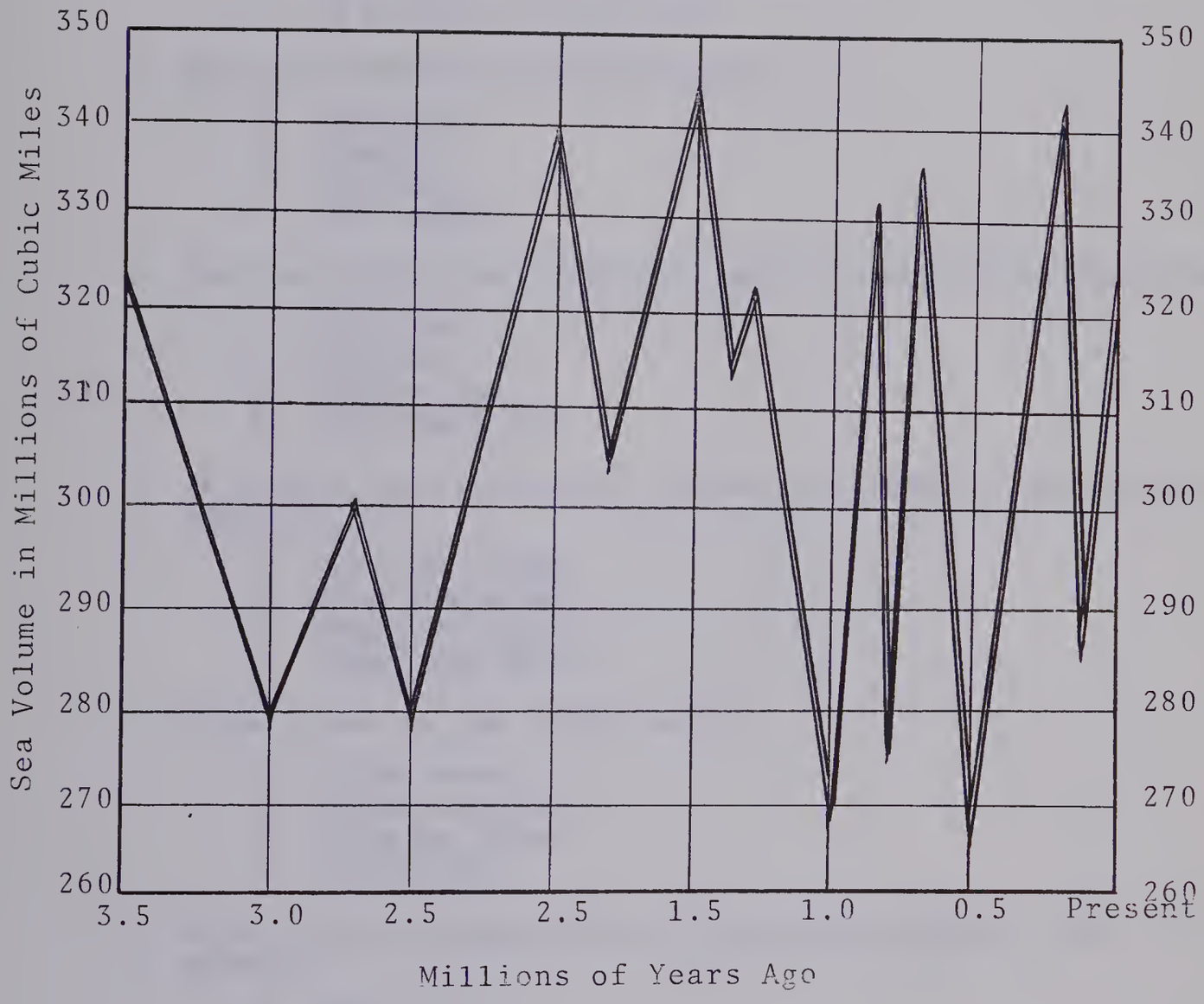

FIGURE 3. Hypothetical Variations in Sea Volume

1. Glaciers now cover

    1. about 10 per cent of the world's land area.
    2. about 10 per cent of the world's surface area.
    3. about 60 million square miles.
    4. only the polar regions.

2. The glaciers in the Antarctic influence the weather

    1. only in the southern hemisphere.
    2. only in the northern hemisphere.
    3. primarily in the northern hemisphere.
    4. in all parts of the world.

3. The ice in glaciers does <u>not</u> control

    1. sea level
    2. climate
    3. wind speed
    4. water supply

4. The line dividing the areas of accumulation and loss is called the

    1. firn line
    2. dew line
    3. glacier line
    4. loss-runoff line

5. As compared with our present climate, the climate of the world in 3000 B.C. was

    1. drier and colder.
    2. drier and warmer.
    3. damper and colder.
    4. damper and warmer.

6. Where is most of the world's water?

    1. in the oceans
    2. in the atmosphere
    3. below the ground
    4. in glaciers

7. Which of the following is one of the natural physical states of matter?

    1. ice
    2. frozen
    3. solid
    4. hard

8. Icebergs are formed by

    1. the freezing of sea water.
    2. glaciers advancing into the oceans.
    3. glaciers forming over the oceans.
    4. snow falling into the oceans.

9. The world's second largest glacial area is in

    1. Antarctica
    2. Canada
    3. Greenland
    4. Siberia

10. In which physical state is most of the earth's water?

    1. liquid
    2. frozen
    3. gaseous
    4. ice

11. Hans Ahlmann did not study the glaciers in

    1. Antarctica
    2. Greenland
    3. Iceland
    4. Scandinavia

12. Approximately what per cent of the world's land surface was covered with ice during the great ice ages?

    1. 10
    2. 20
    3. 30
    4. 40

13. We now live in a period which is neither glacial nor nonglacial. Which of the following is the best evidence of this fact?

    1. Extremely large glaciers are melting.
    2. The climate is constantly changing.
    3. The annual snowfall is decreasing.
    4. Some glaciers are growing and others are shrinking.

14. According to Table 2, glaciers can be found in

    1. Africa
    2. Europe
    3. South America
    4. all of these places

15. The thickness of glaciers is primarily determined by the

    1. land surface.
    2. altitude of the glacier.
    3. average temperature of the area.
    4. amount of snowfall.

16. How many ice ages have occurred during the last million years?

    1. 1
    2. 2
    3. 3
    4. 4

17. According to Figure 3, what was the maximum volume of water and when did it occur?

    1. 265 million cubic miles, 1/2 million years ago.
    2. 345 million cubic miles, 1 1/2 million years ago.
    3. 339 million cubic miles, 2 million years ago.
    4. 270 million cubic miles, 1 million years ago.

18. What per cent of the earth's water budget exists as water vapor?

    1. less than 1
    2. 4
    3 10
    4. 86

19. Of the five continental ice sheets formed during the last ice age two remain. One of them is located in

    1. Canada
    2. Greenland
    3. Norway
    4. Siberia

20. There are fewer glaciers in northern Alaska than in southern Alaska because northern Alaska has

    1. colder weather.
    2. less snowfall.
    3. more snowfall.
    4. fewer valleys in which glaciers could form.

APPENDIX C

COMPREHENSION QUESTIONS USED

Table 1. Mendeleef 1870

Groups:		I	II	III	IV	V	VI	VII	VIII
Typical Elements:		H Li	Be	B	C	N	O	F	
Periods 1.	Series 1. 2.	Na K	Mg Ca	Al -	Si Ti	P V	S Cr	Cl Mn	FeCoNiCu
2.	3. 4.	(cu) Rb	Zn Sr	- Y?	- - Zr	As Nb	Se Mo	Br -	RuRhPdAg
3.	5. 6.	(Ag) Cs	Cd Ba	In -	Sn Ce	Sb -	Te -	I -	- - -
4.	7. 8.	- -	- -	- -	- -	- Ta	- W	- -	OsIrPtAu
5.	9. 10.	(Au) -	Hg -	Tl -	Pb Th	Bi -	- U	- -	- - -

TABLE 2.

ELECTRON CONFIGURATIONS of the ELEMENTS

Electrons occupy orbitals up to and including atomic number except where triangular marking (◤) indicates that one outer-shell electron drops back to an unfilled inner orbital.

Non-metals are indicated by bar markings above symbols.

Increasing Energy

	s		p						d										f													
1	1.01 H 1	4.00 He 2																														
2	6.94 Li 3	9.01 Be 4	10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10																								
3	23.0 Na 11	24.3 Mg 12	27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.5 Cl 17	39.9 Ar 18																								
4	39.1 K 19	40.1 Ca 20	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36	45.0 Sc 21	47.9 Ti 22	51.0 V 23	52.0 Cr 24	54.9 Mn 25	55.9 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.4 Zn 30														
5	85.5 Rb 37	87.6 Sr 38	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	96.0 Mo 42	99.0 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48														
6	133 Cs 55	137 Ba 56	204 Tl 81	207 Pb 82	209 Bi 83	210 Po 84	210 At 85	222 Rn 86	139 La 57	179 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	140 Ce 58	141 Pr 59	144 Nd 60	145 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	163 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
7	223 Fr 87	226 Ra 88							227 Ac 89	104	105	106	107						232 Th 90	231 Pa 91	238 U 92	237 Np 93	242 Pu 94	243 Am 95	245 Cm 96	249 Bk 97	249 Cf 98	253 Es 99	254 Fm 100	256 Md 101	102	103

Group Numbers	I a	II a	III b	IV b	V b	VI b	VII b	0	III a	IV a	V a	VI a	VII a	VIII		I b	II b	Lanthanides (above) and Actinides
	Representative Elements							Inert Gases	Related Metals									Similar Metals

1. According to Table 2,

    1. H (#1) is heavier than He (#2).
    2. La (#57) is heavier than Ce (#58).
    3. Th (#90) is heavier than Pa (#91).
    4. Po (#84) is heavier than At (#85).

2. According to Table 2, which of the following elements has the greatest amount of chemical energy?

    1. Ca (#20)
    2. Kr (#36)
    3. Ag (#47)
    4. Tm (#69)

3. The atomic weight of oxygen (O) when compared to that of flourine (F) is

    1. lower
    2. the same
    3. not comparable
    4. higher

4. According to Table 1, the chemical properties of which pair of elements are most similar?

    1. Rb and Hg
    2. Mg and Al
    3. Ni and Cu
    4. Na and K

5. According to Table 2, the chemical elements americium (Am, #95) and curium (Cm, #96) are

    1. representative elements.
    2. inert gases.
    3. related metals
    4. similar metals.

6. After studying his original Table, Mendeleef decided that

    1. iodine should be placed in front of tellurium.
    2. iodine had been assigned a false atomic weight.
    3. tellurium had always been in its proper position.
    4. tellurium should be placed in fromt of iodine.

7. An important use for the periodic table would be to

    1. develop new methods of classifying elements.
    2. give the total number of elements.
    3. predict new elements.
    4. predict properties of new elements.

8. The element Mendeleef called eka-silicon (eka-Si) is now known as

    1. gallium (Ga, #31)
    2. germanium (Ge, #32)
    3. zirconium (Zr, #40)
    4. Niobium (Nb, #41)

9. Mendeleef thought he had misplaced iodine and tellurium in his table because

    1. the accepted weight of iodine was less than that of tellurium.
    2. their known properties were not the same.
    3. their known properties were the same.
    4. the accepted weight of iodine was more than that of tellurium.

10. According to Table 2, calcium (Ca, #20) has chemical properties most similar to

    1. Potassium (K, #19)
    2. Aluminum (Al, #13)
    3. Scandium (Sc, #21)
    4. Zinc (Zn, #30)

11. When oxygen combines with an element from Group I, the ratio of Group I atoms to oxygen atoms is

    1. two to three.
    2. two to one.
    3. one to one.
    4. three to two.

12. According to Table 2, the number of electrons occupying orbitals in the element aluminum (Al, #13) is

    1. 5
    2. 12
    3. 13
    4. 27

13. The heaviest non-metal is

    1. I (#53)
    2. Te (#52)
    3. Po (#84)
    4. At (#85)

14. According to Mendeleef in Table 1, the number of undiscovered elements in Group II was

    1. one
    2. two
    3. three
    4. four

15. The correct ordering of elements according to increasing atomic weights is

    1. F, Cl, Na.
    2. Na, Cl, F.
    3. F, Na, Cl.
    4. Cl, F, Na.

16. Which pair of elements is most likely to combine?

    1. Ne (#10) and Ar (#18)
    2. K (#19) and Cl (#17)
    3. Xe (#54) and K (#19)
    4. Rn (#86) and Cs (#55)

17. Mendeleef's table can be best described as

    1. a chemical table arranged in increasing atomic numbers.
    2. a table of chemical elements arranged in a precise order.
    3. an orderly grouping of chemical elements.
    4. a periodic table of chemical elements.

18. Mendeleef's basis for placing tellurium (Te #52) before iodine (I, #53) was

    1. the general characteristics of the two elements indicated that their order should be reversed.
    2. the discoverer of tellurium was noted for careless work, therefore Mendeleef assumed him to be in error.
    3. sound experimentation proved that the weight of iodine was wrong.
    4. the atomic numbers of the two elements indicated that their order should be reversed.

19. According to the reading passage the Zero Group

    1. cannot be scientifically isolated.
    2. will not unite with atoms of other elements.
    3. do not fulfill the conditions of the Periodic Table.
    4. Are the only elements in gaseous form.

20. Which of the following is most active?

    1. Fluorine (F)
    2. Chlorine (Cl)
    3. Bromine (Br)
    4. Iodine (I)

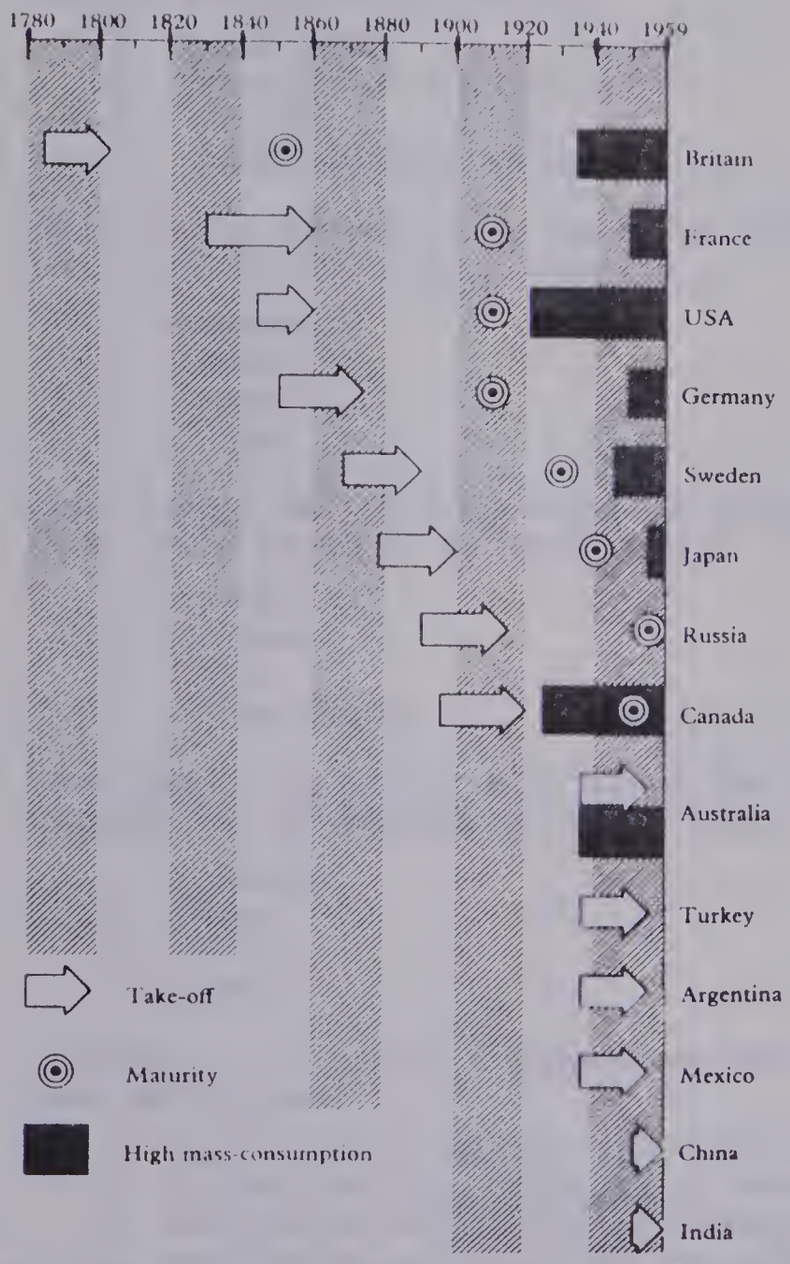

Chart of the stages of economic growth in selected countries. Note that Canada and Australia have entered the stage of high mass-consumption before reaching maturity. [By courtesy of the *Economist*.]

The length of each arrow indicates the length of the take-off stage.

1. If progress is defined as movement from the traditional society to the age of high mass-consumption, then progress does not necessarily provide for increased

    1. leisure time.
    2. material goods.
    3. religious dedication.
    4. standard of living.

2. In which stage of economic development is the relative power of the central government the weakest?

    1. traditional
    2. precondition for take-off
    3. take-off
    4. technological maturity

3. Based on the information in the chart, probably the process of industrialization is least complete in

    1. Australia
    2. Canada
    3. France
    4. Sweden

4. Which one of the following countries did not pass through the stages of economic growth in the usual order?

    1. Australia
    2. Britain
    3. India
    4. United States

5. According to the chart, which one of the following countries probably has the highest per capita income?

    1. Australia
    2. China
    3. Mexico
    4. Canada

6. According to the chart, a country can enter the stage of high mass-consumption

    1. only after it reaches technological maturity.
    2. without reaching technological maturity.
    3. only after take-off has been completed.
    4. without going through the traditional stage.

7. Before take-off can begin the citizens must accept

    1. a lower standard of living.
    2. government control of business.
    3. control by the land owners.
    4. constant change.

8. In the second paragraph of the passage Keynes said ".... as a result of cold calculation." What did he mean?

    1. As a result of a desire to improve society.
    2. As a result of objective planning.
    3. As a result of regulatory legislation.
    4. As a result of power seeking.

9. During drive-to-maturity, labor unions would

    1. lose membership.
    2. be controlled by the government
    3. change the social structure.
    4. increase their influence.

10. Which of the following would most likely be a major export from a country in the transitional stage of economic growth?

    1. farm machinery
    2. paper products
    3. furniture
    4. crude oil

11. According to the chart, the Canadian nation-wide railroad system was probably completed about

    1. 1820
    2. 1840
    3. 1900
    4. 1920

12. In which stage of economic development would the productive rate of investment most likely exceed 15% of the national income?

    1. traditional
    2. precondition for take-off
    3. take-off
    4. drive to maturity

13. One trend appearing in the chart is that countries today, compared to countries a century ago

    1. require more time for take-off
    2. seldom reach high mass-consumption.
    3. move through the transitional stage more quickly.
    4. move from take-off to high mass-consumption more quickly.

14. Which of the following countries had the longest period of take-off?

    1. Britain
    2. Canada
    3. France
    4. Turkey

15. Which of the following countries reached maturity first?

    1. Australia
    2. Canada
    3. France
    4. Sweden

16. Which of the following is <u>least</u> characteristic of a country in the stage of maturity?

    1. Half of the population is involved in agriculture.
    2. Demands for consumer goods exceed production.
    3. Factories are expanding rapidly.
    4. Heavy industry is emphasized.

17. Unionization, the labor movement, or the banding together of workers to protect their rights is probably most characteristic of which stage?

    1. traditional
    2. take-off
    3. drive to matrity
    4. high mass-consumption.

18. In which stage is the economy most dependent on weather conditions?

    1. traditional
    2. preconditon for take-off
    3. take-off
    4. drive to maturity

19. Which of the following actions would most quickly move a country from the traditional to the transitional stage?

    1. Build a technical college.
    2. Have a war with a neighboring country that is in the maturity stage.
    3. Hire an outstanding scientist from a country in the transitional stage.
    4. Build a national system of airports.

20. According to the chart, in 1940 Sweden was in which stage of economic growth?

    1. take-off
    2. drive to maturity
    3. maturity
    4. high mass-consumption.

Table 1. Distribution of Water Volume

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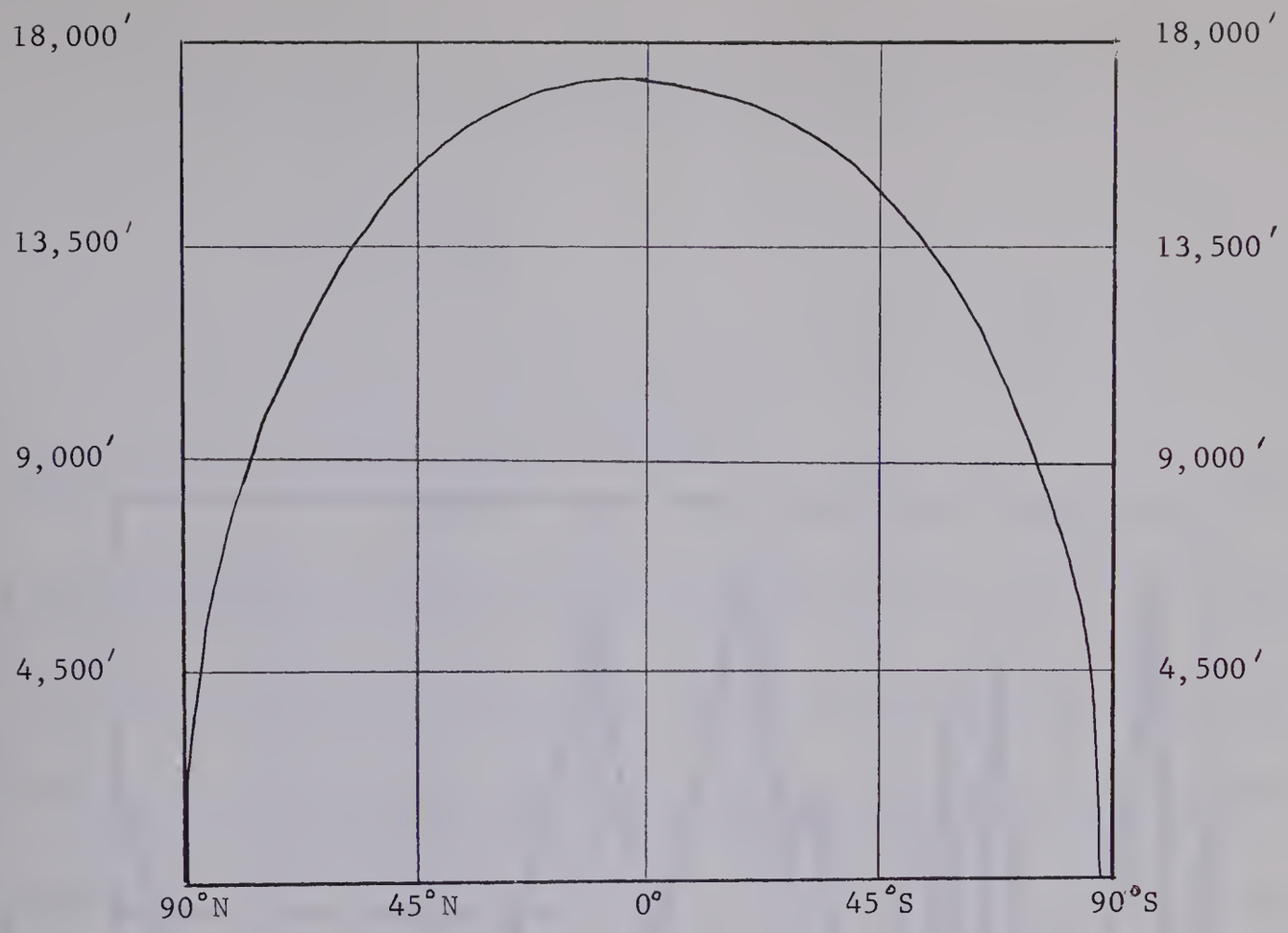
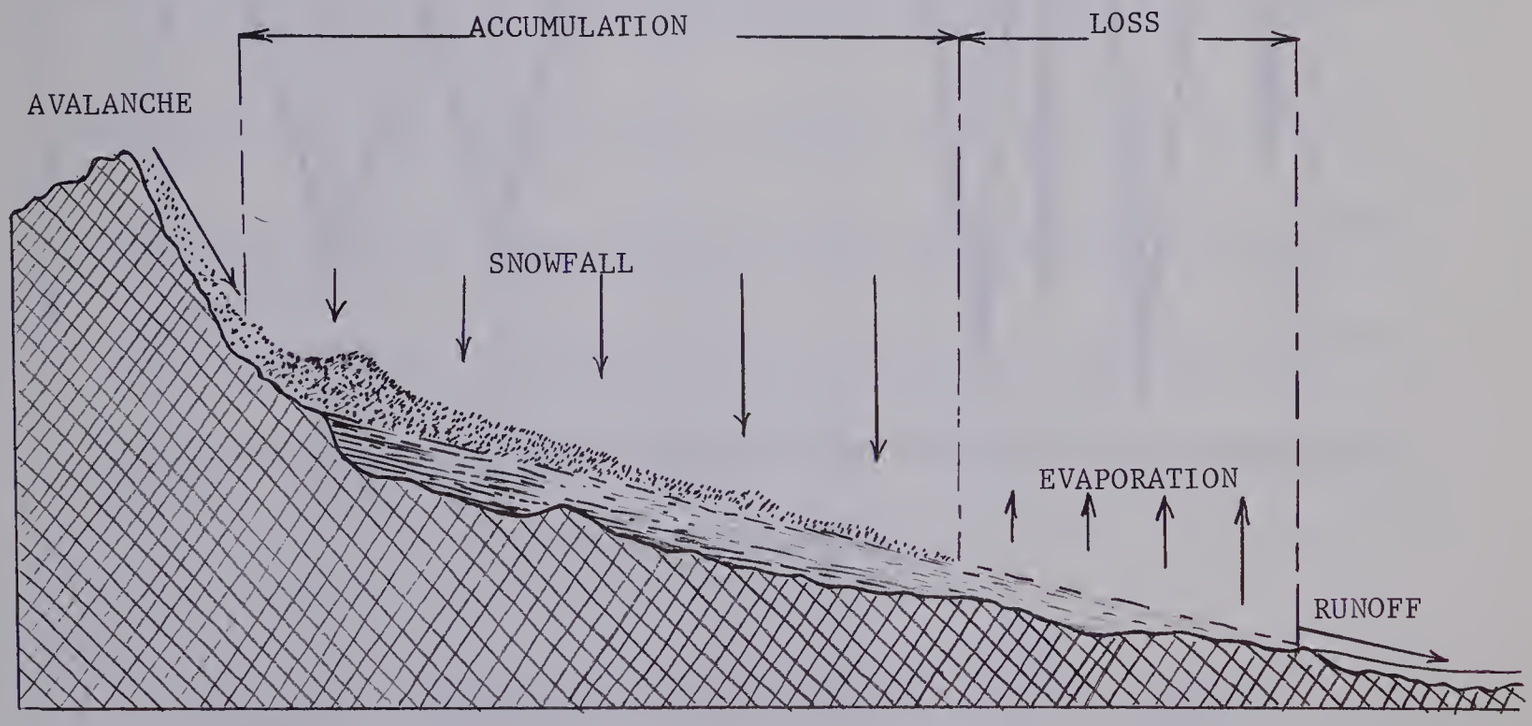


FIGURE 1. Approximate height of snow at various latitudes.



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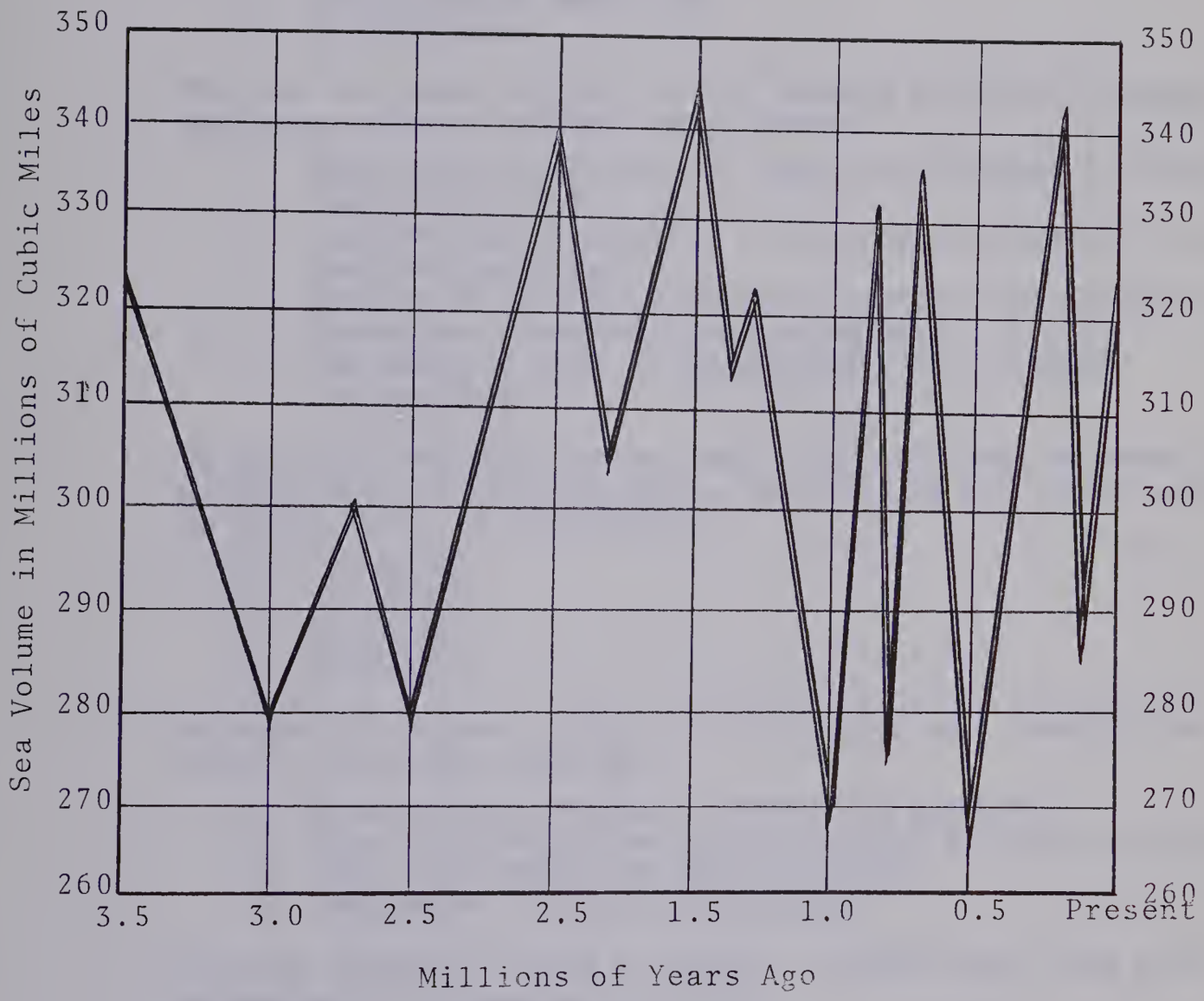

FIGURE 3. Hypothetical Variations in Sea Volume

1. During the last ice age, the highest summer temperatures in what is now the southeastern United States was approximately

    1. 70 degrees
    2. 85 degrees
    3. 110 degrees
    4. 120 degrees

2. Approximately 96 per cent of the glacial area of the world is located

    1. in the southern hemisphere.
    2. outside the temperate zone.
    3. in the eastern hemisphere.
    4. in Antarctica.

3. The size and number of glaciers have remained relatively unchanged during the past two thousand years; however,

    1. there have been substantial changes from century to century during the period.
    2. sea level has increased by 2 1/2 inches each century for the last five centuries.
    3. glaciers in the United States have disappeared but those in Europe have increased in number and size.
    4. the volume of water in the atmosphere has increased substantially.

4. If glaciers cover about ten per cent of the land area, or about six million square miles of the earth, then the land area of the earth, in square miles, is approximately

    1. 5,400,000
    2. 6,000,000
    3. 54,000,000
    4. 60,000,000

5. According the Figure 3, which of the following best describe the world 1 1/2 million years ago.

    1. It was almost completely covered with glaciers.
    2. There were deep valley glaciers in high mountainous regions.
    3. There were probably no glaciers at all.
    4. Continental ice sheets were growing.

6. From the information given in Figure 1, glaciers could form at 45 degrees north latitude provided that

    1. there is enough pressure.
    2. the altitude is 15,000 feet or higher.
    3. there are no forested areas.
    4. the temperature never gets low enough to prevent snowfall.

7. The fact that the great Alaskan glaciers are located in forested areas implies that these glaciers are

    1. part of a vast ice cap.
    2. the world's thickest glaciers.
    3. remaining portions of a receding ice cap.
    4. temperate zone glaciers.

8. If all of the ice in Antarctica were melted by artificial means and all other ice areas remained the same then the maximum rise in the world's oceans would be

    1. 60 feet
    2. 170 feet
    3. 240 feet
    4. 210 feet

9. According to Figure 3, how did world conditions one million years ago compare to those of 1 1/2 million years ago?

    1. Similar, cold and dry.
    2. Similar, warm and humid.
    3. Dissimilar, almost opposite.
    4. Not enough information is given to make comparison.

10. The total volume of water in the world's glaciers is approximately

    1. one million cubic miles.
    2. two million cubic miles.
    3. four million cubic miles.
    4. seven million cubic miles.

11. The term "RUNOFF" which appears in Figure 2

    1. is defined clearly in the reading passage.
    2. is not essential for understanding glaciers.
    3. restates the central idea of glacier formation.
    4. is a synonym for "melt."

12. Which of the following best describes conditions during the past 2,000 years?

    1. Glaciation has fluctuated.
    2. Sea level has been constantly decreasing.
    3. America's continental glaciers have disappeared, but Europe's have not.
    4. Water in the atmosphere has decreased.

13. The purpose of Figure 2 is to

    1. present a picture of glacial formation.
    2. show areas of a glacier where snowfall and evaporation occur.
    3. introduce the concept of runoff.
    4. show one of the results of an avalanche.

14. The Antarctic ice sheet is approximately the size of

    1. Europe and Asia.
    2. the United States and Russia.
    3. the United States and Mexico.
    4. the Arctic ice sheet.

15. Glaciers stopped advancing over North America when

    1. they reached the mild climate south of the Topic of Cancer.
    2. accumulation exceeded loss.
    3. the snowfall failed to keep pace with the annual melt.
    4. the edges reached the sea and formed icebergs.

16. Which change would make Figure 2 more descriptive of valley glacier formation?

    1. Add snowfall arrows to include the entire figure.
    2. Extend accumulation line to include the area marked evaporation.
    3. Add snowfall arrows to include the area marked avalanche.
    4. Add evaporation arrows to include the area marked runoff.

17. According the Figure 3, the smallest amount of water in solid form existed how many million years ago?

    1. 1/2
    2. 1
    3. 1 1/2
    4. 2

18. The serious study of glaciers began about the time of the

    1. Civil War.
    2. Golden Age of Greece.
    3. French Revolution.
    4. discovery of America.

19. A glacier can best be described as a

    1. snow field.
    2. moving ice field.
    3. product of low temperature.
    4. valley packed with ice.

20. The great continental ice sheets disappeared from the United States and Europe about

    1. 3,000 years ago
    2. 5,000 years ago
    3. 250,000 years ago
    4. 500,000 years ago.

APPENDIX D

APPLICATION QUESTIONS USED

Table 1. Mendeleef 1870

Groups:		I	II	III	IV	V	VI	VII	VIII
Typical Elements:		H Li	Be	B	C	N	O	F	
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3.	5. 6.	(Ag) Cs	Cd Ba	In -	Sn Ce	Sb -	Te -	I -	- - -
4.	7. 8.	- -	- -	- -	- -	- Ta	- W	- -	OsIrPtAu
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TABLE 2.

ELECTRON CONFIGURATIONS of the ELEMENTS

Electrons occupy orbitals up to and including atomic number except where triangular marking (◤) indicates that one outer-shell electron drops back to an unfilled inner orbital.

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Increasing Energy

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3	23.0 Na 11	24.3 Mg 12	27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.5 Cl 17	39.9 Ar 18																								
4	39.1 K 19	40.1 Ca 20	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36	45.0 Sc 21	47.9 Ti 22	51.0 V 23	52.0 Cr 24	54.9 Mn 25	55.9 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.4 Zn 30														
5	85.5 Rb 37	87.6 Sr 38	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	96.0 Mo 42	99.0 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48														
6	133 Cs 55	137 Ba 56	204 Tl 81	207 Pb 82	209 Bi 83	210 Po 84	210 At 85	222 Rn 86	139 La 57	179 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	140 Ce 58	141 Pr 59	144 Nd 60	145 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	163 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
7	223 Fr 87	226 Ra 88	227 Ac 89	104	105	106	107												232 Th 90	231 Pa 91	238 U 92	237 Np 93	242 Pu 94	243 Am 95	245 Cm 96	249 Bk 97	249 Cf 98	253 Es 99	254 Fm 100	256 Md 101	102	103

Group Numbers	I a	II a	III b	IV b	V b	VI b	VII b	0	III a	IV a	V a	VI a	VII a	VIII		I b	II b	Lanthanides (above) and Actinides
	Representative Elements							Inert Gases	Related Metals									Similar Metals

1. Why did Mendeleef leave gaps in his table?

    1. He believed that forthcoming discoveries would need the spaces.
    2. He could not find elements with the characteristics for these spaces.
    3. Atomic weights of known elements could not be determined.
    4. He did not know enough about the chemistry of known elements.

2. How many protons does the element Ac have?

    1. 0
    2. 56
    3. 89
    4. 138

NOTE: The symbol (#) stands for atomic number.

3. The symbol for the element which has only one proton and one electron is

    1. H (#1)
    2. He (#2)
    3. Y (#39)
    4. Ac (#89)

4. Group II in Mendeleef's table which contains magnesium (Mg), calcium (Ca) and strontium (Sr), has spaces for other elements. Which one of the missing elements is shown in that group in Table 2?

    1. Barium (Ba)
    2. Radium (Ra)
    3. Cesium (Cs)
    4. Zinc (Zn)

5. Approximately what per cent of the weight of sodium (Na, #11) is neutrons?

    1. 30
    2. 50
    3. 70
    4. 90

6. The element which has 9 electrons, 10 neutrons, and 9 protons is

    1. Be (#4)
    2. F (#9)
    3. Ni (#28)
    4. Ne (#10)

7. How many electrons does the element nitrogen (N) have?

    1. 0
    2. 5
    3. 7
    4. 14

8. An atom with unequal numbers of protons and neutrons is

    1. Hydrogen (H, #1)
    2. Helium (He, #2)
    3. Carbon (C, #6)
    4. non-existent

9. Identify the element with the following characteristics:

    A. Its atomic weight is between 133 and 256.
    B. It is a representative element.
    C. It is a non-metal.

    This element is

    1. Te (#52)
    2. I (#53)
    3. Po (#84)
    4. At (#85)

10. Which of the following best describes Mendeleef's attitude toward his findings?

    1. He would apply his theory regardless of the consequences to his reputation.
    2. New fields of research were open to chemists.
    3. The relationships he had discovered were possibly coincidental.
    4. The results would probably hold true even though is work was largely guesswork.

11. If their existence had been known, which of the following pairs of elements would have been most difficult for Mendeleef to place?

    1. Am (#95) and Cm (#96)
    2. Cm (#96) and Bk (#97)
    3. Bk (#97) and Cf (#98)
    4. Tb (#65) and Bk (#97)

12. Which of the following has an assumption <u>basic</u> to Mendeleef's work?

    1. All elements could be classified in 7 groups.
    2. Miscalculated atomic weights would show up in his table.
    3. Elements can be arranged in an orderly sequence based on chemical properties.
    4. Many elements were yet to be discovered; therefore, his table would be incomplete.

13. How many neutrons does the element helium (He) have?

    1. 0
    2. 2
    3. 3
    4. 4

14. The atomic weight of water (H_2O) is

1. 3
2. 10
3. 18
4. 20

15. An ion which has a charge of -1

1. has an extra proton.
2. is missing an electron.
3. has an extra electron.
4. has an extra proton and electron.

16. The ratio of neutrons to protons in the element carbon (C, #6) is

1. 1 to 1
2. 1 to 2
3. 4 to 3
4. 2 to 1

17. Suppose one was given a compound whose formula was "?"$_2$O. Which group would contain the element indicated by the question mark?

1. I
2. II
3. III
4. IV

18. Which of the following non-metals is most active?

1. Oxygen (O, #16)
2. Chlorine (Cl, #17)
3. Iodine (I, #52)
4. Actinium (Ac, #89)

19. If a new element were discovered with an atomic weight of 258, which of the following is the best estimate of its atomic number?

1. 102
2. 106
3. 107
4. Must be larger than 107.

20. According to Table 2, which of the following is a characteristic of hydrogen (H, #1)?

1. One outer shell electron drops back.
2. It is a non-metal.
3. It is heavier than He.
4. It is a metal.

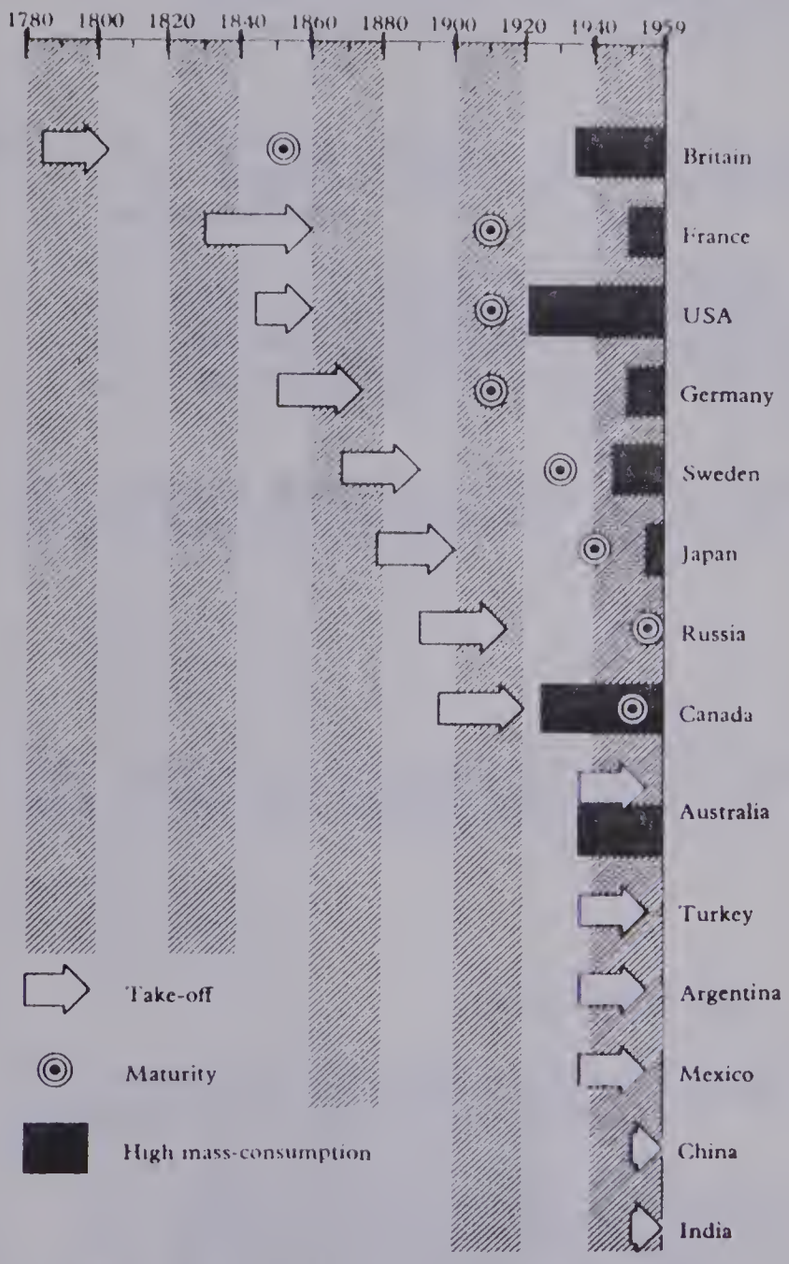


Chart of the stages of economic growth in selected countries. Note that Canada and Australia have entered the stage of high mass-consumption before reaching maturity. [By courtesy of the *Economist*.]

The length of each arrow indicates the length of the take-off stage.

MAKE NO MARKS ON THIS PAGE. ANSWERS ARE TO BE RECORDED ON ANSWER SHEETS.

1. Which of the following actions would do least to move a nation from the traditional to the transitional stage?

    1. Strengthen the central government.
    2. Encourage landowners to invest most of their income in industries.
    3. Introduce modern farming techniques to increase production.
    4. Reduce the compulsory retirement age.

NOTE: The following information must be used in answering questions 2-3: Suppose a country exists which has the following four characteristics:

a. It is very large and is controlled by a strong dictator.
b. 80% of the population are farmers.
c. The rate of investment is about 5% of the national income.
d. The educational level of the general population is low.

2. This country is like countries in the traditional state in how many of the four characteristics?

    1. 1
    2. 2
    3. 3
    4. 4

3. This country is like countries in high mass-consumption in how many of the four characteristics?

    1. 0
    2. 1
    3. 2
    4. 3

****

4. The statement, "the last country to reach the age of high mass-consumption was the United States" is

    1. true, according to the chart.
    2. probably true, but the chart does not indicate it definitely.
    3. false, according to the chart.
    4. probably false, but the chart does not indicate it definitely.

5. Which of the following is not characteristic of a country in the traditional stage?

    1. Average family size increased over last year.
    2. 95% of the land is owned by 15% of the population.
    3. National corn harvest was the largest ever.
    4. Manufacture of tractors showed a 200% increase over last year.

6. Prior to the Civil War, cotton was the most important product of the South. What is the most advanced stage in which the pre-Civil War South could be properly classified?

    1. traditional
    2. precondition for take-off
    3. take-off
    4. drive to maturity

7. Which one of the following countries most likely has more than 50% of its labor force in agriculture at the present time?

    1. Argentina
    2. Australia
    3. Canada
    4. Sweden

8. In which stage would the occupation of "social worker" be the most common?

    1. transitional
    2. take-off
    3. drive to maturity
    4. high mass-consumption

9. The statement, "two countries which violated the order of Rostow's stages of economic growth were Canada and Australia" is

    1. true, according to the chart.
    2. probably true, but the chart does not indicate it definitely.
    3. false, according to the chart.
    4. probably false, but the chart does not indicate it definitely.

10. According to the chart, which of the following countries has probably been a major exporter of manufactured goods over the longest period of time?

    1. Canada
    2. France
    3. Japan
    4. Sweden

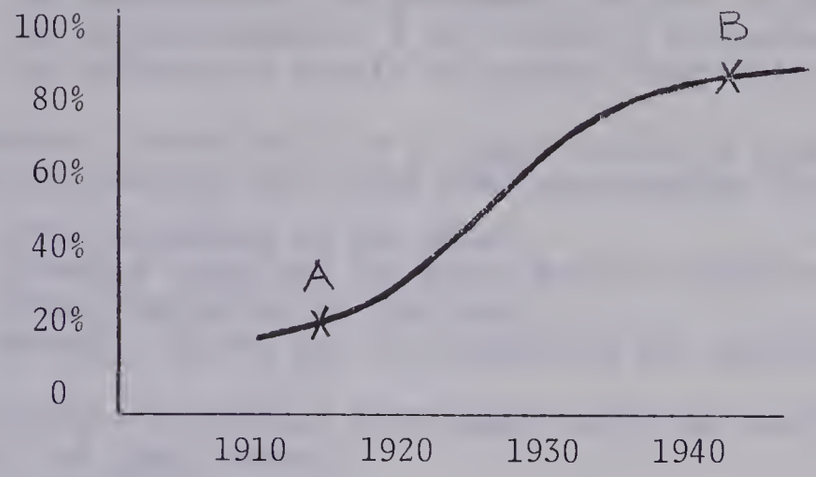
11. The statement, "Australia will completely skip the maturity stage" is

    1. true, according to the chart.
    2. probably true, but the chart does not indicate it definitely.
    3. false, according to the chart.
    4. probably false, but the chart does not indicate it definitely.

12. The statement, "if Britain had started its take-off 60 years later, the time between its maturity and the age of high mass-consumption would have been shorter" is

    1. true, according to the chart.
    2. probably true, but the chart does not indicate it definitely.
    3. false, according to the chart.
    4. probably false, but the chart does not indicate it definitely.

NOTE: This graph, showing the per cent of non-agricultural workers in the total labor force each year in a particular country, must be used in answering questions 13-14.



13. According to the graph, which stage of growth is represented by point A?

    1. traditional
    2. precondition for take-off
    3. take-off
    4. drive to maturity

14. According to the graph, which stage of growth is represented by point B?

    1. traditional
    2. precondition for take-off
    3. take-off
    4. drive to maturity

****

15. The statement, "of all the countries shown on the chart, Britain has the longest interval of time between maturity and high mass-consumption" is

    1. true, according to the chart.
    2. probably true, but the chart does not indicate it definitely.
    3. false, according to the chart.
    4. probably false, but the chart does not indicate it definitely.

16. Suppose you know the following information about a country:
    a. half of the employed citizens are farmers;
    b. the number of banks has doubled in the past 5 years;
    c. its chief export is wheat and its chief import is farm machinery.

    This country is probably in the

    1. traditional stage
    2. precondition for take-off stage.
    3. take-off stage.
    4. drive to maturity stage.

17. Which of the following events would most likely move a country from the traditional to the transitional stage?

    1. The discovery of a new strain of corn.
    2. The overthrow of the government by army officers.
    3. The establishment of a new industry to manufacture rifles.
    4. The building of canals to provide inexpensive transportation.

18. The statement, "there will be a longer period of time between the take-off and maturity for China than was required for Britain" is

    1. true, according to the chart.
    2. probably true, but the chart does not indicate it definitely.
    3. false, according to the chart.
    4. probably false, but the chart does not indicate it definitely.

19. In which stage of economic development would the occupation of "college professor" be <u>least</u> common?

    1. traditional
    2. precondition for take-off
    3. take-off
    4. drive to maturity

20. The statement, "Turkey will never enter the stage of high mass-consumption" is

    1. true, according to the chart.
    2. probably true, but the chart does not indicate it definitely.
    3. false, according to the chart.
    4. probably false, but the chart does not indicate it definitely.

Table 1. Distribution of Water Volume

LOCATION	CUBIC MILES
Water in the oceans (close estimate)	329,000,000
Water in the atmosphere (rough estimate)	3,600
Water in glaciers (average of high and low estimates)	4,200,000
Water in lakes and rivers (rough estimate)	55,000
Ground water above 12,500 feet (very rough estimate)	1,080,000
Ground water below 12,500 feet (very rough estimate)	19,700,000

Table 2. Distribution of Ice by Area

LOCATION	SQUARE MILES
Africa	8
Antarctica	5,019,000
Asia	42,200
Canadian Arctic Islands	45,000
Europe	4,370
Greenland	666,300
North America	30,890
Northern Atlantic and European Arctic Islands	45,400
Pacific Islands	392
South America	9,650
Sub-Antarctica Islands	1,160
World Total	5,864,370

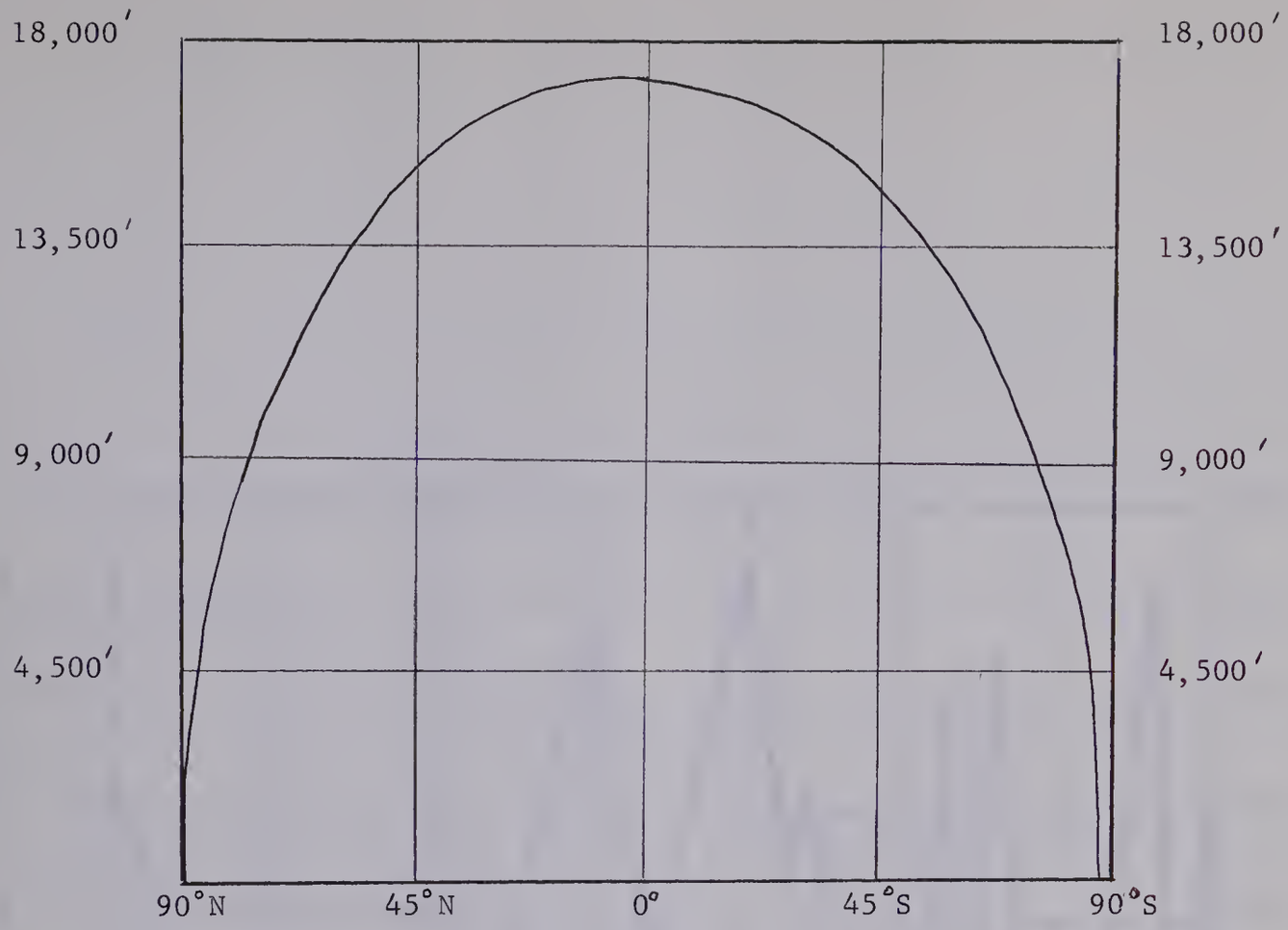


FIGURE 1. Approximate height of snow at various latitudes.

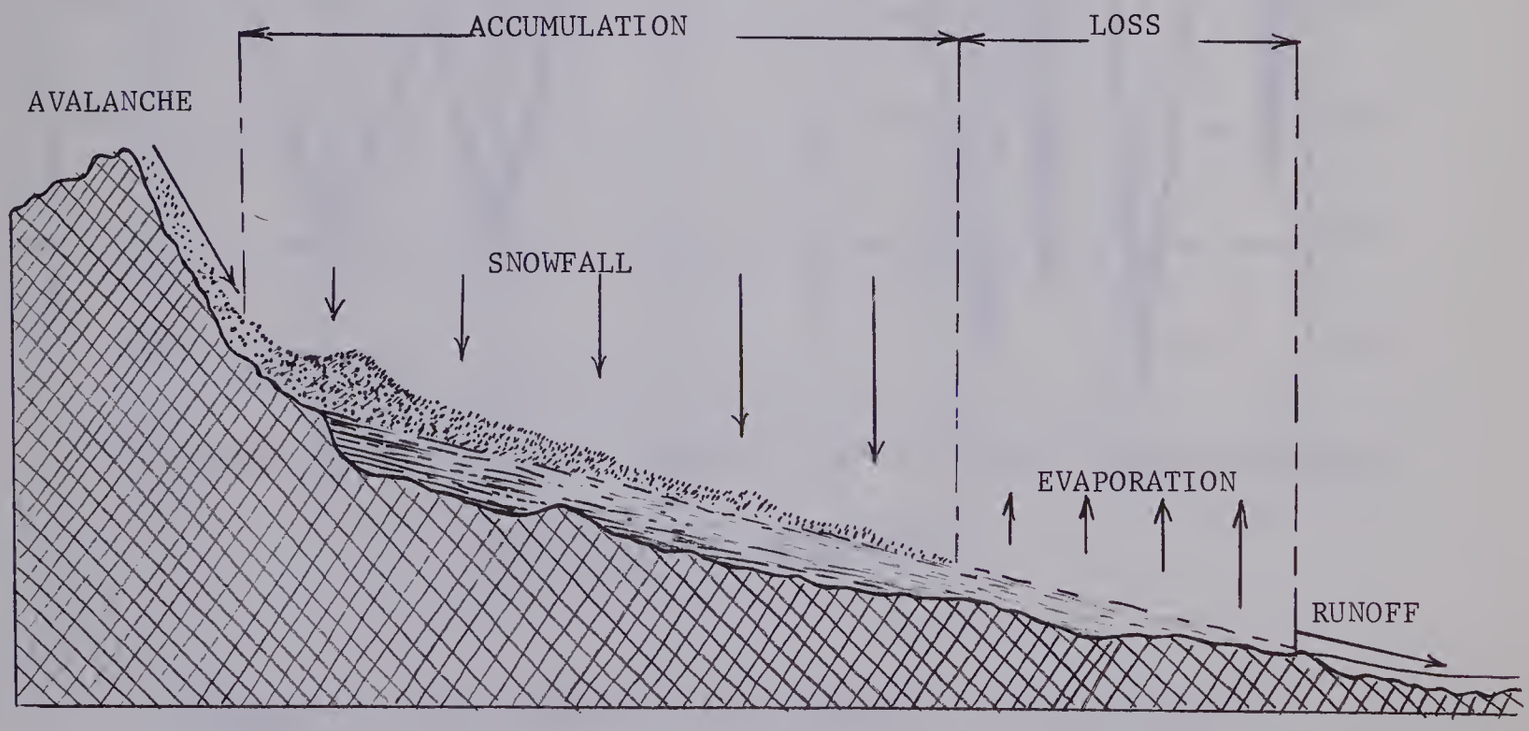


Figure 2. LIFE OF A GLACIER is depicted in this cross section of an ideal valley glacier. Falling snow carried by avalanche is compressed into ice, which begin to move by its own weight. The line dividing the areas of accumulation and loss is the firn line, where total accumulation equals total melting. Variations in snowfall, temperature and other conditions determine whether the glacier advances.

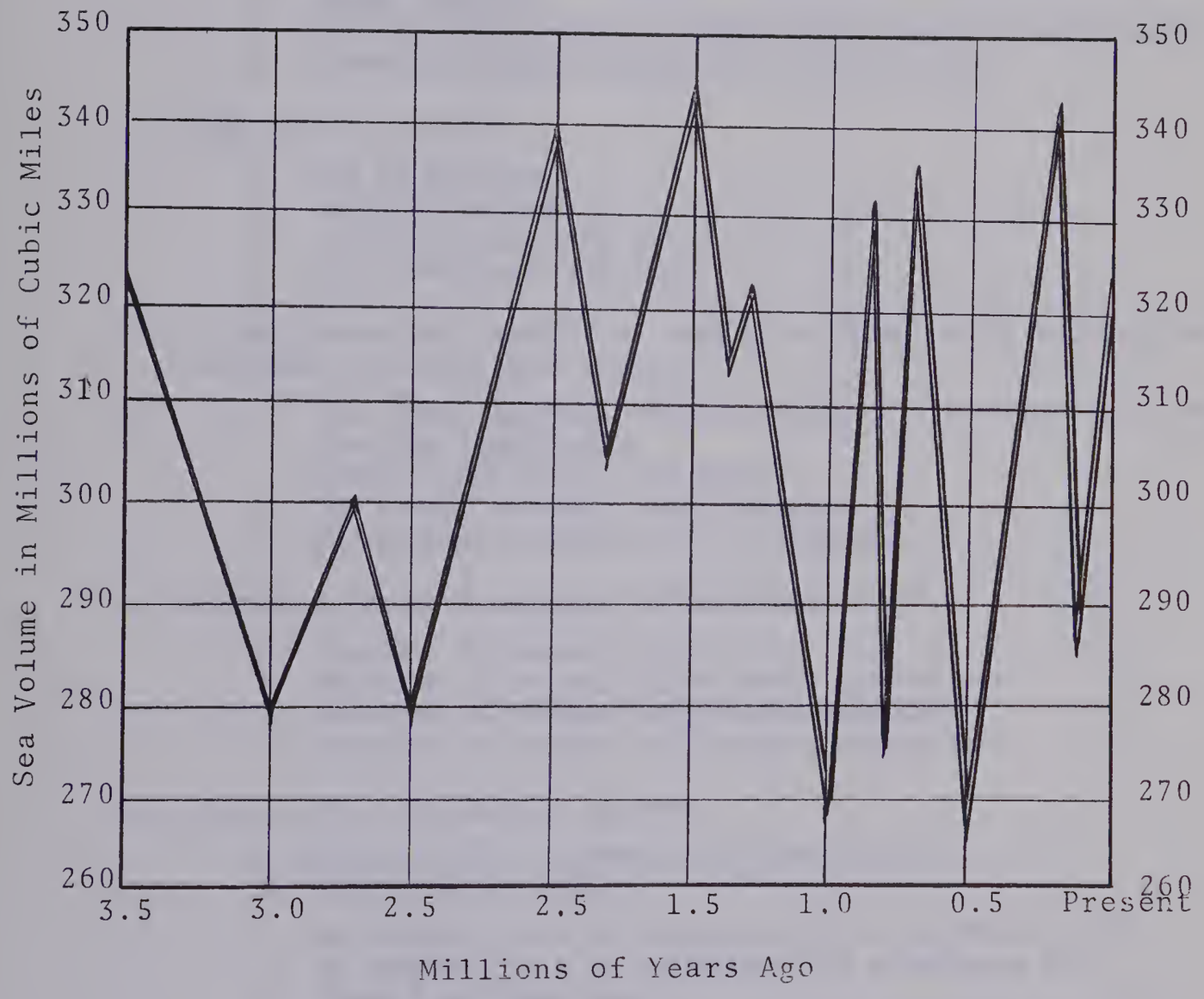
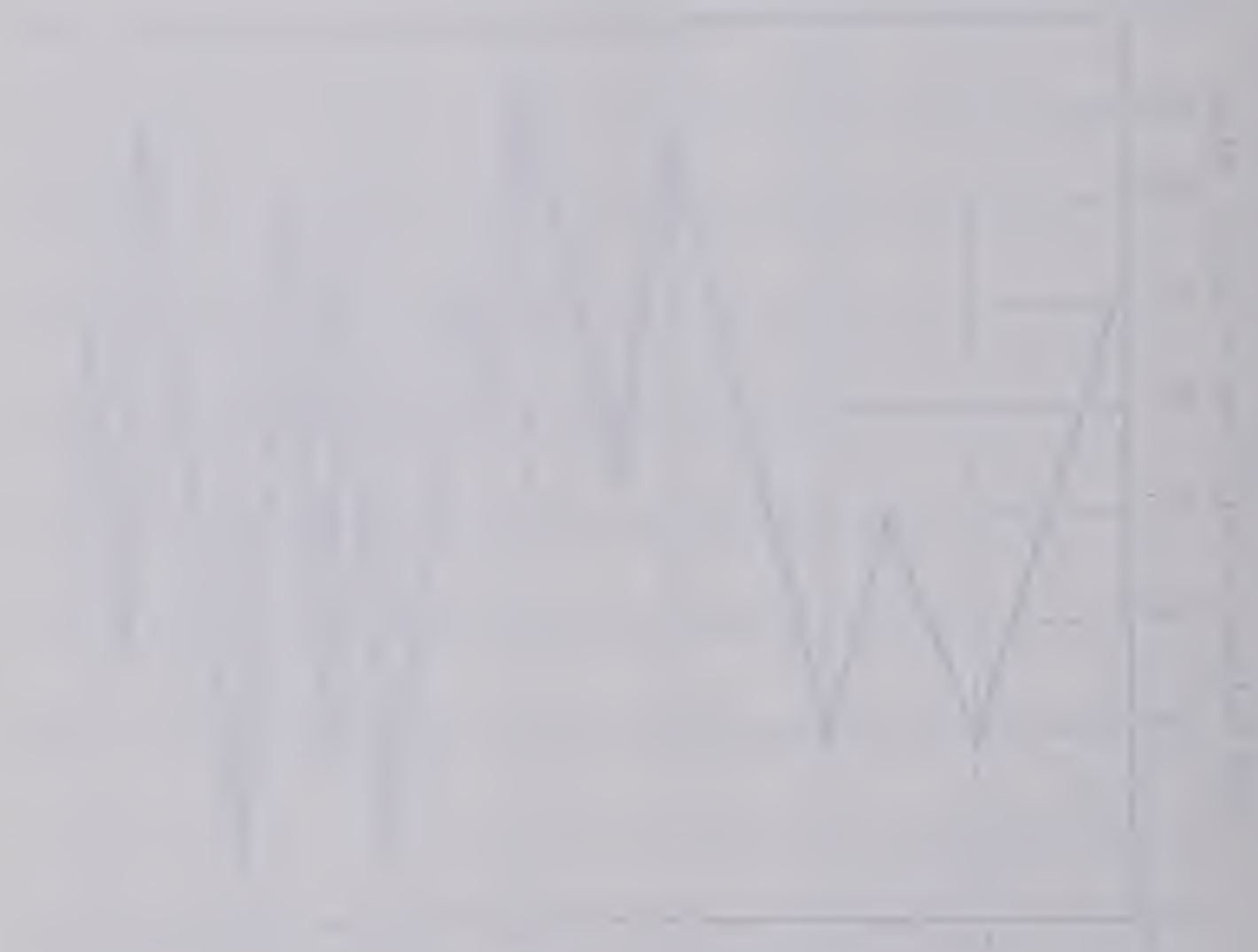


FIGURE 3. Hypothetical Variations in Sea Volume



1. Refer to Table 1. The ratio of water in glaciers to water in the oceans is about

   1. 1/75
   2. 1/15
   3. 1/8
   4. 1/30

NOTE: The following information applies to questions 2-4. Assume the following about the conditions of a geographic area:

A. average annual snowfall is 10,000 cubic feel per square mile.
B. average daily high temperature in 70 degrees F. in the summer months.
C. average annual melt is 10,000 cubic feel per square mile.
D. these conditions have existed for 100 years.

2. This region probably

   1. has no glaciers.
   2. is highly glaciated.
   3. is near a glaciated area.
   4. has a few small glaciers.

3. If the annual melt were to be reduced to 9,500 cubic feet per year, how would the conditions change?

   1. The annual snowfall would decrease to less than 9,500 cubic feet per square mile.
   2. Glaciers would begin to form.
   3. The annual snowfall would increase.
   4. The glaciers would begin to disappear.

4. What would cause a decrease in the annual melt?

   1. Increase in annual snowfall.
   2. Decrease in average daily summer temperature.
   3. Decrease in average atmospheric pressure.
   4. Increase in average daily winter temperature.

5. What is the relationship between

   A. Melting of the Antarctic ice sheet, and
   B. Area of North Dakota.

   1. An increase in A is accompanied by an increase in B.
   2. An increase in A is accompanied by a decrease in B.
   3. A and B are unrelated.
   4. The relationship cannot be determined from the passage.

6. Assume that 5 million cubic miles of water are contained in the world's glaciers. If the glaciers melted completely, approximately how many feet would ocean levels rise.

   1. 70
   2. 100
   3. 160
   4. 190

7. What is the relationship between

   A. Number of glaciers near the coast, and
   B. Number of icebergs in the ocean.

   1. An increase in A is accompanied by an increase in B.
   2. An increase in A is accompanied by a decrease in B.
   3. A and B are unrelated.
   4. The relationship cannot be determined from the passage.

8. What might happen if the earth's glaciers were to melt during the next decade?

   1. Greenland would develop into an important nation.
   2. The great seaports of the world would disappear under water.
   3. Antarctica would emerge as a large continental mass.
   4. Australia would submerge.

9. What is the relationship between

   A. Glaciation of North America, and
   B. Prevailing temperature in southeast United States.

   1. An increase in A is accompanied by an increase in B.
   2. An increase in A is accompanied by a decrease in B.
   3. A and B are unrelated.
   4. The relationship cannot be determined from the passage.

10. What is the relationship between

   A. Average world temperature, and
   B. Amount of water in the oceans.

   1. An increase in A is accompanied by an increase in B.
   2. An increase in A is accompanied by a decrease in B.
   3. A and B are unrelated.
   4. The relationship cannot be determined from the passage.

11. What is the relationship between

   A. Amount of glaciation in the world, and
   B. Surface area of land.

   1. An increase in A is accompanied by an increase in B.
   2. An increase in A is accompanied by a decrease in B.
   3. A and B are unrelated.
   4. The relationship cannot be determined from the passage.

NOTE: The following information must be used in answering questions 12-14:

The earth has existed many millions of years during which its ocean content was not always 330 million cubic miles. From the preceding statement and what you know of earth history, answer question 12-14 according to the following key:

KEY:
1. Water content exceeded 330 million cubic miles.
2. Water content was less than 330 million cubic miles.
3. Water content remained 330 million cubic miles.
4. No evidence exists for a valid conclusion.

12. During the time of the last ice sheet is North America.

13. During the time when most of the Caribbean Islands were larger than they are now.

14. When the volume of water in the Great Lakes was at its maximum.

****

15. What is the relationship between
A. Amount of snowfall, and
B. Amount of glaciation.

1. An increase in A is accompanied by an increase in B.
2. An increase in A is accompanied by a decrease in B.
3. A and B are unrelated.
4. The relationship cannot be determined from the passage.

16. If the glacier shown in Figure 2 is located at latitude 68 degrees N, according to the information given in Figure 1, "RUNOFF" would begin at approximately

1. 4,500 feet
2. 9,000 feet
3. 10,500 feet
4. 13,500 feet

17. The author states that we are living in an exceptional era with regard to glaciation. Which one of the following would substantiate this statement the least from the physical standpoint?

1. A new continental glacier is forming.
2. The world is partially glaciated.
3. The Arctic Ocean is open water.
4. A systematic study of glaciers is taking place.

18. What is the relationship between
A. Altitude of snow line, and
B. Average rainfall.

1. An increase in A is accompanied by an increase in B.
2. An increase in A is accompanied by a decrease in B.
3. A and B are unrelated.
4. The relationship cannot be determined from the passage.

19. The process of converting snow to ice in the formation of a glacier is similar to the process of making

    1. steam from water.
    2. wool by sheep.
    3. rayon from chemicals.
    4. coal from vegetation.

20. What is the relationship between
    A. Distance from the Poles, and
    B. Average wind velocity.

    1. An increase in A is accompanied by an increase in B.
    2. An increase in A is accompanied by a decrease in B.
    3. A and B are unrelated
    4. The relationship cannot be determined from the passage.

APPENDIX E

ACHIEVEMENT TEST USED

1. The statement, "Lisbon is the capital of Portugal," is

    1. a guess.
    2. not true.
    3. supported by the reading passage
    4. impossible to make from the reading selection alone.

2. The number of persons killed in the earthquake was undoubtedly increased because stone was used for

    1. sea walls.
    2. streets and sidewalks.
    3. sidewalls of buildings.
    4. roofs of buildings.

3. What is the relationship between the following statements?

    A. Voltaire, Rousseau, and other prominent philosophers were Frenchmen.
    B. The center of controversy regarding the "Theology of Earthquakes" was in France.

    1. A caused B
    2. B caused A
    3. A and B are related, but one did not cause the other.
    4. A and B are unrelated.

4. King Jose I appointed Pombal to the position of

    1. Minister of Foreign Affairs and War.
    2. Chief Justice.
    3. Dictator.
    4. Chief Magistrate

5. Many of Pombal's measures were short lived because

    1. they were too modern.
    2. they were emergency reforms.
    3. they were not endorsed by the clergy.
    4. of foreign intervention in Portugal's affairs.

6. Which of the following would most likely have done as Nero did--"Fiddle while Rome burned?"

    1. Kant
    2. Pombal
    3. Rousseau
    4. Voltaire

7. What characteristic of a medieval society discouraged modernization of Portugal?

    1. Political and economic power of the nobles and clergy.
    2. The existence of an old section in the towns.
    3. Great emphasis on religion.
    4. Lack of trade with other countries.

8. The disasters at Hiroshima and Lisbon were alike in that both
   1. happened in the spring.
   2. were man-made.
   3. called for universal re-thinking.
   4. were eathquakes.

NOTE: The following information must be used in answering questions 9-11:

Voltaire and Leibniz might have argued about whether or not the following conclusion was true: Great social, political, and economic reforms are needed and men are justified in putting forth their greatest effort in this direction." Decide how Voltaire and Leibniz would have used each of the following statements, if at all, in arguing about this conclusion. Mark your answer according to the following key:

KEY:
1. Voltaire would have used the statement to argue that the conclusion was true.
2. Leibniz would have used the statement to argue that the conclusion was true.
3. The statement has no bearing on the argument.
4. The statement relates to the argument, but neither would have used it.

9. All events have been predetermined since the beginning of time.

10. Man has a responsibility to society.

11. Natural disasters cause great suffering.

****

12. The article states that the tremors of the Lisbon earthquake were felt over a wide area. In which of the following countries were these tremors most violent?
    1. England
    2. Germany
    3. Italy
    4. Spain

13. What is the relationship between the following statements?

    A. Scarcity of food.
    B. Scarcity of building materials.

    1. A caused B
    2. B caused A
    3. A and B are related, but one did not cause the other.
    4. A and B are unrelated.

14. What is the relationship between the following statements?

A. Scarcity of food.
B. Control of prices of food.

1. A caused B
2. B caused A
3. A and B are related, but one did not cause the other.
4. A and B are unrelated.

15. Immediately following the earthquake Pombal's major concern was to

1. rebuild the city.
2. prevent looting.
3. provide shelter.
4. prevent a plague.

16. Dr. Johnson said that he was "weary of hearing about the subject." He was dissatisfied with the

1. lack of interest in the Lisbon problem.
2. overly optimistic viewpoint of others.
3. lack of interest in philosophical arguments.
4. amount of material written about the subject.

17. The greatest damage to articles such as books, tapestries, and paintings was probably caused by

1. fire.
2. tremors.
3. water.
4. wind.

18. Which one of the following would have been most likely to break with tradition?

1. Kant
2. Leibniz
3. Rousseau
4. Voltaire

19. What is the relationship between the following statements?

A. A philosophical controversy which lasted the better part of a century.
B. The Lisbon earthquake.

1. A caused B
2. B caused A
3. A and B are related, but one did not cause the other.
4. A and B are unrelated.

20. Prices of food and building material were strictly controlled after the earthquake to prevent.

1. inflation.
2. profiteering.
3. shortages.
4. waste.

21. How many earth shocks were felt in the Lisbon earthquake?

    1. 2
    2. 3
    3. 4
    4. 5

22. Which of the following was not true of the Lisbon earthquake?

    1. It happened during evening services.
    2. A tidal wave also struck.
    3. The sun was obscured part of the time.
    4. It occurred about 10 o'clock in the morning.

23. Which of the following philosophers would have most likely supported Pombal's policies?

    1. Kant
    2. Leibniz
    3. Rousseau
    4. Voltaire.

24. What is the relationship between the following statements?

    A. An earthquake
    B. The rise of a dictator

    1. A caused B
    2. B caused A
    3. A and B are related, but one did not cause the other.
    4. A and B are unrelated.

25. Persons caught looting the ruins were punished by execution

    1. without a fair trial.
    2. by the soldiers who caught them.
    3. after a summary trial.
    4. after a long delay.

26. The first country to offer aid to Lisbon was

    1. France.
    2. Great Britain.
    3. Norway.
    4. Spain.

27. If an earthquake of the same magnitude as the Lisbon earthquake were to occur today in a large Canadian city,

    1. aid would be needed from foreign countries.
    2. the city would be self-supporting, and outside aid would be unnecessary.
    3. a philosophical argument similar to Lisbon's would begin.
    4. it would make headlines for a few weeks, then it would be forgotten.

28. If the earthquake had not occurred, which of the following would have been most likely?

    1. King Jose I would have become an obsolute monarch.
    2. Pombal would have lost his power and influence.
    3. Pombal would have had a less profound influence on Portugal's future.
    4. The Chief Justice would have become the most powerful person in Portugal.

29. Assume that flood waters have ruined the agricultural area of a foreign country and millions will starve unless aid is received. Were he living now, which one of the following individuals would most likely advocate that U.S. surplus crops be made available to the distressed country?

    1. Kant
    2. Leibniz
    3. Rousseau
    4. Voltaire

30. Which of the following <u>was not</u> offered by Great Britain to help Portugal?

    1. clothing
    2. food
    3. lowering the trade tariffs
    4. money

31. In which country is the westernmost European capital?

    1. France
    2. Norway
    3. Portugal
    4. Spain

32. Pombal was able to assume complete power following the earthquake because he was

    1. a member of the nobility.
    2. the spokesman of the people.
    3. established in the power structure of Portugal.
    4. well like by the king and his court.

33. A viewpoint which <u>cannot</u> be found in the reading passage is that of

    1. an observer
    2. a scientist
    3. a philosopher
    4. an historian.

34. Which of the following is both a sequential relationship and a cause-and-effect relationship?

    1. All Saints' Day celebration--Lisbon earthquake.
    2. Consideration of moving to Rio de Janeiro--Pombal's rise to power.
    3. "Theology of Earthquakes"--extensive news coverage of the Lisbon earthquake.
    4. The Lisbon earthquake--European aid to Portugal.

35. The response of the English Parliament in 1775 served the function of what agency today?

1. United Nations
2. International Workers of the World
3. Red Cross
4. Overseas Refugee Association

36. What is the relationship between the following statements?

A. Many ships were destroyed during the earthquake.
B. Tariff regulations were changed following the earthquake.

1. A caused B
2. B caused A
3. A and B are related, but one did not cause the other.
4. A and B are unrelated.

37. On which of the following days did the Lisbon earthquake occur?

1. All Saints' Day
2. Christmas
3. Easter
4. Good Friday

38. What is the relationship between the following statements?

A. Pombal's conflict with the nobility and the clergy.
B. Modernization of Portugal.

1. A caused by B
2. B caused by A
3. A and B are related, but one did not cause the other.
4. A and B are unrelated.

39. "Man or at least a lower species contributed looting and murder to the scene of despair." In this sentence "lower species" most nearly means

1. non-noblemen and working men.
2. looters and robbers.
3. animals of high order.
4. morally inferior men.

40. What was Voltaire's profession?

1. orator
2. writer
3. painter
4. physician

41. What action, if any, would Pombal probably have taken if most of the skilled craftsmen like carpenters and bricklayers had left Lisbon immediately following the earthquake?

1. None, because there would have been fewer people to feed and shelter.
2. None, because other areas needed these people more than Lisbon did.
3. Action to return them so they could help rebuild the city.
4. Action to return them so they could be punished for leaving.

42. What is the relationship between the following statements?

A. There were many fires in Lisbon after the earthquake.
B. Most of the inhabitants of Lisbon observed religious holidays.

1. A caused B
2. B caused A.
3. A and B are related, but one did not cause the other.
4. A and B are unrelated.

43. If the Lisbon earthquake had happened after Thomas Edison invented the light bulb, which of the following would have been most likely?

1. The tidal wave could have been averted.
2. There would have been fewer fires.
3. There would have been a minimum amount of dust.
4. The "boisterous," stormy wind would not have arisen.

44. Which one of the following contributed most toward the continuing discussion of the "Theology of Earthquakes"?

1. The issue was very controversial and many philosophers were interested in it.
2. The progress of science was at stake for the rest of the century.
3. Acceptance or rejection of Leibniz's philosophy would govern man's attitude toward his world.
4. The common man was interested in having a better life.

45. At the time of the earthquake, Lisbon society could best be described as

1. enlightened.
2. medieval.
3. progressive.
4. modern.

46. Before the earthquake, Pombal was

1. dictator of Portugal.
2. a dominant figure in Portuguese politics.
3. influentieal among the common people.
4. a noted philosopher.

47. Which of the following statements best represents Pombal's philosophy of life?

1. What is to be will be.
2. Might makes right.
3. God punishes guilty and innocent alike.
4. Bury the dead and feed the living.

48. If man were to misuse nuclear fission and fusion which person's philosophy would have the least relevance?

1. Leibniz
2. Pombal
3. Rousseau
4. Voltaire.

49. From which point of view was the passage written?

1. historical
2. military
3. political
4. scientific

50. How could you best describe the statement that "Lisbon has vanished? It is

1. absurd
2. accurate
3. exaggerated
4. unsubstantiated

51. What is the relationship between the following statements?

A. Charging of unreasonable prices for rent.
B. Rent control following the earthquake.

1. A caused B.
2. B caused A.
3. A and B are related, but one did not cause the other.
4. A and B are unrelated.

52. Which fact about Pombal is most consistent with the belief that he accepted the philosophy of Voltaire?

1. He did not move the capital to Rio de Janeiro.
2. He was ruthless.
3. He broke with tradition.
4. He used Voltaire's poem, "The Lisbon Earthquake," as his guide to reconstruct Lisbon.

53. A "mental seismograph" is a

1. scientific device for detecting ideas.
2. figure of speech for the mind.
3. mental record.
4. mechanical device for recording earthquakes.

54. Which one of the following would most likely <u>not</u> have been a "good Samaritan"?

1. Kant
2. Leibniz
3. Pombal
4. Voltaire

55. Why was the Lisbon earthquake the basis of much philosophical discussion?

1. A capital of a country was destroyed.
2. Many of Portugal's treasures were lost.
3. Pombal's form of government was a dictatorship.
4. 30,000 or more inhabitants were killed in the disaster.

56. Parliament is a representative assembly in

1. Great Britain.
2. Norway.
3. Portugal.
4. Spain.

57. Which of the following best describes the reason aid was given to Lisbon?

1. A feeling of sorrow and charity.
2. A desire for extra rights in rich colonies.
3. A feeling of loyalty and friendship for a neighboring country.
4. A desire to establish good relations for possible future benefit.

58. Who was the author of Candide?

1. Kant
2. Leibniz
3. Rousseau
4. Voltaire.

59. Lisbon was rebuilt

1. in a haphazard manner.
2. outside the old city limits.
3. without using brick or stone.
4. according to a master plan.

60. "What is, is right," is most nearly equivalent to

1. "what is to be, will be."
2. "the end justified the means."
3. "might makes right."
4. "the sky is the limit."

APPENDIX F

EXAMPLE OF INSTRUCTIONS

INSTRUCTIONS

1. On your desk you should have an optical scoring sheet and a stack of reading passages each followed by a brown envelope. DO NOT rearrange the order of the material. You may find it helpful to leave the rubber band holding the material together.

2. Please DO NOT MARK the reading passages or questions, as they will be used again.

3. Your name should be on the optical scoring sheet, if it is not report to the teacher. Fill in your AGE, GRADE, and the DATE.

4. Remove the first reading passage from the stack of material and read the instructions on the front page.

5. Read and study the reading passage carefully. You should use about 15 minutes to do so.

6. Put the reading passage aside and remove the contents from the first brown envelope. Inside you will find a set of questions and a smaller white envelope. Do not open the white envelope until you have answered all the questions.

7. Answer the questions by placing your response in the column of the optical scoring sheet which corresponds to the reading passage. Indicate your answer by marking the correct alternative.

8. Answer all the questions you can. If you are in doubt about the answer to a question then guess.

9. You should use about 15 minutes to answer all the questions.

10. After having answered all the questions, checked how well you performed by comparing your responses with the correct responses contained in the white envelope, count the number of correct responses you obtained and enter the number on your answer sheet.

11. Place the questions, white envelope, and reading passage into the large brown envelope and set to one side.

12. Remove the next reading passage and repeat the procedure.

13. After completing the experiment, hand in the four brown envelopes and optical scoring sheets. Please place them on separate piles.